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WITMER STONE

(1866 to 1939)

BY WHARTON HUBER

In the passing of Dr. Witmer Stone on May 23, 1939, the American Society of Mammalogists lost a founder and former president; the world, one of the few remaining great naturalists; those of us who knew him, a staunch friend and sympathetic counselor. His broad knowledge of natural history made him an authority in many of its branches. Although he was primarily an ornithologist, his "The Plants of Southern New Jersey with Especial Reference to the Flora of the Pine Barrens," is an outstanding work in botany. Mammals, birds, reptiles, amphibians, insects, and land mollusks all had their niche in his mind. For twenty-five years, 1912–1937, as editor of The Auk, the publication of the American Ornithologists' Union, he wrote hundreds of reviews of recent publications. His biographical sketches of early American naturalists give us vivid pictures of these pioneers in the natural sciences. He always wrote well; but in "Bird Studies at Old Cape May", his last large work, we find him at his best. Dr. Cornelius Weygandt says: "Witmer Stone was not only of the brotherhood of Wilson and Audubon and Nuttall, but a fellow of Thoreau and Burroughs, Richard Jefferies and W. H. Hudson."

Witmer Stone was born in Philadelphia, Pennsylvania, September 22, 1866, the second son of Frederick D. Stone and Anne E. Witmer. He was educated at the Germantown Academy and at the University of Pennsylvania, class of 1887. He received the following degrees from his alma mater; A. B., 1887; A. M., 1891; Sc. D. (Honorary) 1913; Alumni Award of Merit, 1937. While in college he was elected secretary of his class, an office he continued to hold throughout his life.

For some time after graduation from the University of Pennsylvania he acted as assistant in the library of the Historical Society of Pennsylvania,

where his father was librarian. It was in March, 1888, that he became connected with the Museum of the Academy of Natural Sciences of Philadelphia. For over fifty-one years Dr. Stone served the Academy in the following capacities: Conservator Ornithological Section, 1891–1918; Assistant Curator of the Museum, 1893–1908; Curator of the Museum, 1908–1918; Executive Curator, 1918–1925; Director, 1925–1929; Emeritus Director, 1929–1939; Curator of Vertebrates, 1918–1936; Honorary Curator of Birds, 1938–1939, Vice President of the Academy, 1927 to the time of his death.

He married Miss Lillie May Lafferty, August 1, 1904. It was an ideally happy union.

In 1877, while at Germantown Academy, he met Stewardson Brown, a schoolmate, who was later Curator of the Department of Botany at the Academy. Witmer Stone, his brother Frederick D. Stone, Jr., Stewardson Brown, and his younger brothers, Herbert and Francis H., formed the Wilson Natural Science Association. This organization met in Stone's house where weekly sessions were held and where papers were read with all the formalities of a more serious organization. A room was also set aside for the housing of the collections. A few of the bird and mammal skins from this collection were later presented to the Academy. A specimen of *Peromyscus* from it now before me was collected in August, 1887, at West Bradford Township, Chester County, Pa., where Stone spent many of his summers at the home of his uncle.

Dr. Stone's first visit to the Academy was made when he was a small boy. These visits continued throughout his early youth on Saturdays and holidays, when he spent much of his time browsing through the collections then exhibited to the public. When he took up his duties at the Academy, he found the bird and mammal collections in the deplorable condition that I well remember. The few study skins were housed in the old packing boxes that were then serving as storage cases for types and historic specimens. The specimens were covered with dust and grime from the city. The greater part of the collection was mounted and exhibited to the public in long rows of wall cases, where moisture, mold, and the ravages of insects were taking their toll yearly. Dr. Stone rescued these historic specimens by reducing the types and duplicates to study skins and housing them in insect-proof cases. Many of the grotesquely stuffed mammals that surely would have been destroyed later, but for Dr. Stone, proved to be types described by Le Conte, Du Chaillu, and others. His instinct as a collector saved for the future the great bulk of the historic specimens—a service that will never be forgotten. Many years of his busy life were spent in this salvage work, and in the identification and arrangement of specimens.

Some of Stone's writings were of a popular nature on North American mammals. His technical papers covered various regions in the United States, Alaska, Ecuador, Hawaii, Borneo, Liu Kiu Islands, and Sumatra.

Dr. Stone was a ceaseless worker, seldom putting down his pen until

midnight. His splendid private library at home gave him easy access to references for his nightly work. Always a pacifist in his relations with fellow workers in the Academy, he was ever ready to give of his valuable time, dispensing either counsel or cheer. His dominant traits of kindliness and helpfulness together with the use of diplomatic methods instilled a spirit of coöperation and loyalty in the staff. With all of the seriousness of his work there was always a lighter side, where a merry twinkle of the eye or a hearty laugh showed the buoyancy of spirit beneath the surface. This keen sense of humor and a memory that seldom failed, except in the last few years, made his desk a focal point for fellow workers. It is an inestimable privilege to have known Witmer Stone.

In a paper read before The Delaware Valley Ornithological Club, October 19, 1939, "An Appreciation of Witmer Stone," James A. G. Rehn writes: "One of my vivid recollections is of working with him for many months in the salvaging and rehabilitation of a very large and very famous collection of reptiles which came to the Academy on the death of its owner, Dr. Edward D. Cope, who was probably one of that limited group we call the greatest scientists America has produced. Like many great scholars, Dr. Cope had always been too absorbed in his work and its results to look properly after his tools, and in consequence the alcoholic preservative on his priceless specimens was of varied and uncertain strength, and of all imaginable shades of color. By gently pouring this off we could ascertain the character and consistency of the residue, a word I use advisedly for what was found in numerous cases. The tedium of this work was greatly enlivened by Stone's vivid classification and nomenclature of the various color shades and consistencies referred to as "gorum," "gee," and "goo," to be found in the five gallon glass jars used to receive the discarded solution.

Again, on the departure of one of our members for permanent residence on the West Coast, a four page newsheet was carefully hand printed with a pen by Stone, giving in humerous vein the current doings at the Academy and in the Club, with want ads, personals and cartoons, and sent to keep the absent one informed.

Looking back through the years those of us who knew Witmer Stone as a daily associate, can recall many instances when his humor, as vivid as in boyhood but always kindly, and never malicious, lightened our burdens, made the task shorter, the problems easier to solve, the long trudge shorter."

BIBLIOGRAPHY OF WITMER STONE'S MAMMAL PAPERS

(Some of these papers deal with the general principles of nomenclature, but have at least a bearing on mammalogy.)

1893. A new *Evotomys* from southern New Jersey. Amer. Naturalist, vol. 27, no. 313, pp. 55–56.

1893. Description of a new species of *Neotoma* from Pennsylvania. Proc. Acad. Nat. Sci. Philadelphia 1893, pp. 16–17.

1896. A protest against quadrinominalism. Science, n.s., vol. 4, no. 87, pp. 270–271.
1899. The pumas of the western United States. Science, n.s., vol. 9, pp. 34–35.
1900. Report on the birds and mammals collected by the McIlhenny Expedition to Point Barrow, Alaska. Proc. Acad. Nat. Sci. Philadelphia 1900, pp. 4–48.
1900. Description of a new rabbit from the Liu Kiu Islands and a new flying squirrel from Borneo. Proc. Acad. Nat. Sci. Philadelphia 1900, pp. 460–463.
1902. Felis oregonensis Raf. again. Science, n.s., vol. 15, no. 378, p. 510.
1902. (By Witmer Stone and W. E. Cram) American Animals. A popular guide to the mammals of North America. New York, pp. xxiii + 318, illus.
1902. (By Witmer Stone and J. A. G. Rehn) A collection of mammals from Sumatra with a review of the genera *Nycticebus* and *Tragulus*. Proc. Acad. Nat. Sci. Philadelphia 1902, pp. 127–142.
1903. (By Witmer Stone and J. A. G. Rehn) On the terrestrial vertebrates of portions of southern New Mexico and western Texas. Proc. Acad. Nat. Sci. Philadelphia 1903, pp. 16–34.
1904. On a collection of birds and mammals from Mount Sanhedrin, California (with field notes by A. S. Bunnell). Proc. Acad. Nat. Sci. Philadelphia 1904, pp. 576–585.
1904. Notes on a collection of California mammals. Proc. Acad. Nat. Sci. Philadelphia 1904, pp. 586–591.
1905. On a collection of birds and mammals from the Colorado Delta, Lower California. Proc. Acad. Nat. Sci. Philadelphia 1905, pp. 676–688.
1906. The relative merits of the "elimination" and "first species" method of fixing types of genera, with special reference to ornithology. Science, n.s., vol. 24, pp. 560–564.
1908. The mammals of New Jersey. Ann. Rept. New Jersey State Museum, Trenton 1907, pp. 33–110, pls. 58.
1912. A protest against changing the International Code of Zoological Nomenclature. Science, n.s., vol. 35, no. 908, pp. 817–819.
1914. On a collection of mammals from Ecuador. Proc. Acad. Nat. Sci. Philadelphia 1914, pp. 9–19.
1917. The Hawaiian Rat. Occas. Papers Bernice Pauahi Bishop Mus., Honolulu, vol. 3, no. 4, pp. 253–260.
1932. The type locality of *Balaena cisarctica* Cope. Jour. Mamm., vol. 13, pp. 81–82.

The Academy of Natural Sciences of Philadelphia, 19th and The Parkway, Philadelphia, Pennsylvania.

OBSERVATIONS ON SLOTHS IN CAPTIVITY AT HIGHER ALTITUDES IN THE TROPICS AND IN PENNSYLVANIA

By Robert K. Enders

In 1937, during work on El Volcan de Chiriqui, Province de Chiriqui, Panama, our party collected two female two-toed sloths, *Choloepus hoffmanni*, with young, at altitudes considerably above those from which this animal has usually been reported. One female was captured on El Salto near Boquete, at an altitude of 6,000 feet. Both mother and young were vigorous and healthy; the female was lactating and showed unmistakable signs of recent ovulation. Another female carrying a young one approximately a month old was collected near El Velo, Finca Lerida, Boquete, at an altitude of 6,900 feet. The young sloth was kept as a pet. Bangs (1902) records specimens from 4,000 to 4,800 feet near Boquete.

On El Volcan, at an elevation of 6,000 feet, water freezes in the dry season. The flora indicates that temperatures below freezing occur in certain areas at this elevation. These areas are restricted in extent, being confined to locations where the cold air settles after the sun goes down. In these areas the temperature rises during the day to 70 degrees F. or higher. In the wet season temperatures do not approach freezing; but they then drop to 55, or even 40 degrees, under the influence of cloud formation, wind, and other factors. Temperatures during the day range about 10 degrees higher than at night. Thus the diurnal range is very great during a part of the dry season, with extremes both higher and lower than those prevailing during the wet season. Adult sloths inhabiting these areas were found to differ from those taken at sea level, chiefly in the length and quality of the hair. The young two-toed sloths taken at this altitude were covered with hair which was very much like dressed beaver, both in texture and color. The hair covering the belly was short. Because equipment was scanty, no body temperatures were taken.

The month-old sloth captured with its mother at 6,900 feet was carried up to 11,525 feet, then taken to sea level, and finally brought to Swarthmore, Pennsylvania. It was exposed, therefore, to temperatures ranging from below freezing to temperatures as high as 100 degrees F. As far as observations were possible, adjustment to this wide range in temperature and altitude was made without difficulty.

When removed from the dead mother the young one clung to the clothes of some person during the day. The first night she was placed in a box along with some heated rocks. Here she slept quietly until the temperature of the stones dropped. On waking, she cried repeatedly until taken into bed by my daughter. Attaching herself to the child's clothing she settled down and slept the night through. Thereafter, she always spent the night in this manner.

While very young she invariably adjusted herself to the body of the person she was with in such a way as to bring her ventral body surface in contact with the carrier. At high altitudes and low temperatures it was evident that this served to conserve body heat. But this reaction was not entirely dependent upon temperature. At sea level, when the nights were so hot that neither covers nor night clothes could be tolerated by a human sleeper, the sloth continued to sleep with her belly in contact with her bedfellow. At lower temperatures when her bedfellow wore clothing, it was comparatively easy for her to keep this contact; her claws grasped the clothing firmly, but she soon learned not to use her claws on the naked skin.

During the night she maintained her position in relation to the sleeper by moving around the body as the sleeper turned. She rested better with a person than alone, even though—when nights were warm—she did not always stay under the covers. She would crawl in or out as she chose, without disturbing the sleeper. On the rare occasions when she was not attached to a person she would sleep in her basket with her claws firmly embedded in an old sweater and the sweater drawn close to her belly.

If placed on the floor or the ground she would bleat and make for the nearest human. Movement was effected by hooking the claws of the forefeet on some unevenness of the surface and then pulling the body forward. A crack in the floor was generally used for purchase for the claws. During this type of locomotion the hindfeet were drawn up without being used as the body was dragged forward. The hindfeet were called into use on surfaces such as those offered by a rug. After many experiences on the floor she became very proficient, but she never failed to climb off the floor at the first opportunity.

As she grew older she would leave the person carrying her to climb over the arms and back of the occupied chair. If left alone on the chair she began to call at once, but would stop calling and continue to climb about as soon as the chair was reoccupied. Apparently, she did not recognize individuals for she was content when carried by a stranger. She showed no fear of a dog, attaching herself to it whenever the dog came within reach.

While the sloth could be aroused at any time, spontaneous activity was most noticeable around six o'clock in the evening. This may have been an adjustment to household routine. At this time she was placed on an arm of my chair and fed from time to time. Between mouthfuls, she clambered over the chair and into my lap, occasionally hooking food off my plate.

When first captured, she was fed diluted evaporated milk from a syringe. Later, peas (raw, cooked, or canned), spinach (both raw and cooked), apples and apple sauce, grapes, oranges, cod liver oil, and cheese were taken. Bread and milk was a favorite food. She liked chocolate cake. Dry foods, such as dried apples and prunes, as well as dry bread, tended to stick to the roof of the mouth from which she removed them by picking off with the claws of

the forefeet. Apples and similar fruits had to be cut in thin slices so she could bite out bits small enough to chew. Large bits of food or leaves were held in the forepaws, either one or both, until eaten.

Restriction of movement aroused her to anger. She hissed, struck out with the forepaws, and tried to bite. However, her anger did not last long. Attempts to jerk her away from support elicited the same response, but she did not resist gentle handling.

The bladder was emptied at approximately six-day intervals, and the colon a few minutes after the bladder. Dipping the hind-quarters in cold water and allowing the water to run off while holding her up by her forelegs induced evacuation. After we learned of this reaction this was done every five days.

During the four months of her captivity, she grew very slowly. Except for this, she seemed to be in good general health. With the arrival of snow in Swarthmore, she continued to be taken out of doors by the children. In December, she appeared to be ill. In a few days her condition became alarming. Her nose was hot, general dehydration was marked, and respirations were intermittent. The breath sounds, heard by stethoscope through the chest wall, were strident, while the heartbeat was inaudible. Breathing became progressively weaker, and she died within a few hours. Autopsy by Dr. Herbert L. Ratcliffe of the Zoological Society of Philadelphia, showed that she died of anemia and non-specific acute infection, probably of gastro-intestinal origin.

[These observations were made and the paper written while I was at work for the Academy of Natural Sciences of Philadelphia and Swarthmore College, assisted by a grant-in-aid from the American Philosophical Society.]

Bureau of Animal Industry, U. S. Department of Agriculture.

BREEDING HABITS OF THE COTTONTAIL RABBIT IN NEW YORK STATE

By W. J. Hamilton, Jr.

Our knowledge of the reproductive behavior of the cottontail (*Sylvilagus floridanus* and its various sub-species) is very incomplete, although important observations have been made within recent years. Seton (1929) has summarized most of the available data on this subject, while the work of Trippensee (1936) has provided pertinent facts. The present paper has been abstracted from field notes that I have made on *Sylvilagus floridanus mearnsii* over the past twelve years in various parts of New York, but chiefly at Ithaca, in the central western part of the state. These observations were usually incidental to other studies but they appear to contain data sufficiently useful to warrant publication. I am indebted to several interested students who have examined dead rabbits and called my attention to rabbit nests that they have found.

Dead rabbits on the highway provide a splendid source of study material. I usually keep a number of razor blades in my car and a quart jar of ten per cent formalin. If one comes upon a rabbit that is in sufficiently good shape to examine, it takes but a moment to slit it open and examine the reproductive organs. If these are desired for further study, they may be quickly removed and placed in the fixative solution.

The breeding season.—Males with enlarged testes are first noted in late December. Practically all fully adult males have greatly enlarged testes by early February, and these organs continue to remain descended until early summer. There is some diminution in their size during July, as Trippensee (1936) has noted in southern Michigan, but the epididymis of these smaller testes contains an abundance of active spermatozoa. Living sperms may be observed in the testes of a majority of males well into September; usually by the middle of this month the testes commence to withdraw into the abdominal cavity and spermatogenesis stops.

I have no evidence that mating occurs prior to early February, although Trippensee mentions gravid females on January 25 and nest young on March 25. These latter, all dead, were in a nest made in the snow. The first mating usually occurs in New York during late February or early March; but inclement weather or some other factor may delay it until late March. In the late winter of 1932, females were shot containing half-time embryos on February 26, March 2, and March 5. Nest young were first found on March 20 and later on March 24. Cottontails were extraordinarily abundant during the winter of 1931–32. Their very abundance may have fostered early breeding, permitting as it probably did more opportunities for receptive females to meet with potent males.

Mating occurred early in 1934, three nests containing 5–8 day old young

being found on April 6, 7, and 10. This would place the mating about March 1, or a few days later. Brown (1935) and Trippensee (1936) have described the mating activity of the cottontail.

Until the late winter of 1938, I found no nest young earlier than April. During that year I visited the extensive Montezuma Marsh near Savannah, New York, on March 12. I found numerous rabbits on the highway, some of which had been killed during the day. Of these, all but one were males with greatly enlarged and descended testes. The other, a female, showed signs of recent partus and apparently had mated a few hours before her death. During the day I tramped the borders of an extensive marsh and in the thickets of silky cornel and red osier I observed many rabbits hopping excitedly about; occasionally they were observed pursuing one another. Within a week (March 18) I was shown a nest of young rabbits, the eyes of which were not yet open. I placed their age at six days, which would suggest February 10 as the date of mating.

Mating was apparently delayed in 1939, for while I examined several females during March, none contained embryos. Rabbits apparently did not breed until April 1 on the Montezuma Marsh. On the night of April 1 scores of rabbits were killed on the highway, a fact that is a good indication of sexual activity. At Ithaca the earliest nest young were seen on April 22. These were approximately three days old.

Nest young have commonly been found late in April, and in May, June, and July of every year. There is little cessation of reproduction in this latter month. Breeding is greatly curtailed in August, about one of every four females examined showing evidence of pregnancy or active lactation. On August 12 and 14, 1937, two female cottontails examined near Albany, New York, contained five small and three large embryos respectively. A female taken on August 22, 1938, at the same place, contained three full term embryos. A female collected on the highway at Cairo, New York, on August 25, 1939, had four well developed embryos. On several occasions young rabbits that could scarcely be more than four weeks old have been taken during the last week of September; but only a single pregnancy record is available from a score of females examined during this month. On September 16, 1936, I found, on the highway at Kingston, New York, a dead rabbit that contained four embryos of about two-thirds time.

On a few occasions in late October I have shot males with enlarged testes, a microscopic examination of which suggested that these individuals were capable of breeding. From these data it would thus appear that the female controls the length of the breeding season, that is, females come into oestrus later in the winter than the males become sexually active and pass into anoestrous in the late summer or early autumn while some males are still capable of fruitful copulation.

Number of litters.—We yet know little of this subject. Trippensee (1936)

states that evidence collected in southern Michigan points to two litters as common and four as possible. This matter can positively be settled only by examination of individual females trapped repeatedly during a single breeding season.

On May 11, 1939, Nicholas Drahos brought me a female that had been killed on an Ithaca highway. On examination she was found to be nursing, the tiny nipples characteristic of rabbits being well filled with milk. I dissected out her mammary glands, which were well filled and weighed 37 grams. This rabbit contained six 50 mm. embryos that were probably about three weeks old. This observation is very suggestive, and leads me to believe that rabbits, like many of our small rodents, mate within a very short time after parturition. I trapped a female on July 14, 1932, that contained four small embryos and was actively nursing. These records suggest that several litters follow one another in rapid succession.

Litter size.—Twenty-two sets of embryos give an average litter size of 4.5. The largest number of embryos was 7, the smallest 2. It is generally considered that embryo counts should be slightly discounted to allow for stillbirths and early post-natal losses. Nevertheless the loss at this period must be rather small, for 17 nests containing young averaged 4.3 rabbits per nest.

Nest life.—We have found considerably more nests in open fields than elsewhere, but this is undoubtedly due to the ease of observation and to the fact that the fur lining, widely spread by predators, especially dogs, is readily seen for some distance. Many nests have been found in shrubby pastures, and in sparse second growth bordering watercourses. In selecting a nesting site the female, I believe, utilizes shallow depressions formed by mouse-hunting skunks, dislodged stones or other ready-made holes that she may find.

The removal of the hair from the belly of the rabbit for nest lining serves a dual purpose. Not only does it provide a warm container for the reception of the young, but it provides easier access to the very small nipples. The fur is actually removed, often quite completely, along the mammary line, forming two long semi-glabrous areas that are often quite prominent.

I have twice been attracted to a nest by the lusty and repeated squealing of young. While the parent seldom, if ever, visits the young during daylight the young may be heard squealing at midday.

In the region where I have made observations, one of the most destructive elements appears to be prolonged spring rain. In spite of its close cover, the nest is often not immune to flooding, and the resultant chilling or actual drowning accounts for a major loss. I have found two nests, and was shown two others, in which dead young occurred, the evidence pointing strongly to death by drowning. Dogs are very destructive to young rabbits, killing great numbers of nest young in the early spring. They often scrape or claw the nest lining over an area of several square yards.

LITERATURE CITED

BROWN, E. E. 1935. Diurnal mating activity of the cottontail. Jour. Mamm., vol. 16, p. 69.

SETON, ERNEST THOMPSON. 1929. Lives of game animals, vol. 4, no. 2, pp. 781–815.

TRIPPENSEE, R. E. 1936. The reproductive function in the cottontail rabbit (*Sylvilagus floridanus mearnsii* (Allen)) in southern Michigan. Proc. North America Wildlife Conference, pp. 344–350.

Department of Zoology, Cornell University, Ithaca, New York.

RANGE OF THE COATI IN THE UNITED STATES

BY F. WALLACE TABER

Vernon Bailey (1905), basing his record on a specimen taken by Dr. J. C. Merrill in 1877 in the Brownsville region, recorded the first occurrence of the coati (*Nasua narica*) in the State of Texas. Thinking that the coati occurred generally from Arizona to Texas south of the international boundary, he predicted other occurrences along the Rio Grande. Sixty-one years have elapsed since the first recorded occurrence in Texas and but two others have been brought to light in the interim.

On November 24, 1938, the author, with four others from the department of wild game at the Agricultural and Mechanical College of Texas, investigated rumors of a strange animal that had been caught by a Mexican a few months earlier near Eagle Pass, Texas. The animal proved to be a coati, which, by that time, had become quite tame, begging food from its admirers and jibbering excitedly as it played to the length of its chain.

On being questioned, the Mexican told of catching the "*chula*" in July, 1938, on the American side of the Rio Grande. It is possible that the animal was caught north of the international boundary, but I am reminded by Ernest G. Marsh, Jr., that the specimen probably was a pet that had escaped from captivity in Piedras Negras, just across the border, to which place they often are brought for sale to American tourists. The coati may have crossed the river of its own voliton, or it may have been smuggled into Texas to avoid complications with American quarantine officials.

The third specimen was captured about January 10, 1939, some 20 miles below Boquillas in the Dead Horse Mountains of trans-Pecos Texas. A game warden, who mistook the skin for an illegally taken river otter, confiscated it from a Mexican trapper and presented it to the Texas Cooperative Research Collection. Because of extreme ruggedness and general inaccessibility, this area seldom is visited by man, but those who have been there report the presence of many tropical plants. In such an association, it is quite conceivable that coatis are present but have thus far escaped notice. Two of the three records thus far discovered appear not to have been natural invasions.

Coatis occur generally, though in restricted areas, over much of the state of Coahuila in Mexico. For the most part, these areas are so situated that travel from one to the other is quite possible. Their distribution from Texas to Arizona south of the international boundary line is not continuous, however. According to Marsh (*in litt.*), in northern Mexico coatis are restricted to the warmer humid canyons of high mountain ranges, places that do not occur at any point near the Mexico-Texas border. Nor are such conditions to be found adjacent to the Mexico-New Mexico border except in the extreme western corner where the Sierra Madre crosses the international boundary.

FIG. 1. Range of the coati in the United States

Similar conditions are to be found along the Sonora-Arizona line in the Patagonia Mountains and again in the Ruby district.

In the southern parts of Arizona and New Mexico a definite northern invasion is taking place. During the past two decades, the coati has risen from the rank of the rare to that of a common part of the native fauna. Many captures and sight records have been recorded in Arizona, one as far north as 40 miles above Clifton, and as many as 70 animals from a single locality. Dr. Charles T. Vorhies, of the University of Arizona, writes me that coatis are rather commonplace in Arizona, being especially abundant in the Huachuca Mountains and in the Ruby district. At the latter locality, one hunter reported seeing a troop of 12 to 15 coatis on a single hunting trip during the

past deer season. Specimens have been reported from the following counties in Arizona; Cochise, Greenlee, Maricopa, Yavapai, Pima, and Santa Cruz.

Coatis are fairly numerous in the vicinity of Cloverdale and in the Animas Mountains in New Mexico. Ellicott S. Barker, State Game Warden, informed me that three have been taken within the past two years in the Gila National Forest, 30 to 40 miles north of Silver City. An adult male specimen collected by W. C. Echols in Pine Canyon of the Animas Mountains on March 25, 1936, is in the U. S. National Museum, Biological Survey collection. On May 7, 1936, in the vicinity of the Heart Bar ranch on the Gila National Forest, Jack Pinkerton of Silver City took a coati that had been treed by his lion dogs. Other records from areas scattered throughout Hidalgo County in New Mexico are available.

Although still confined to the more semi-tropical regions in the United States, the coati has of late greatly enlarged its range. According to Bailey (1931): "The deep barrancos of the Rio de Batepito, cutting southward through Sonora from near the border of New Mexico, bring a number of southern forms into this vicinity."

LOCALITIES WHERE COATIS HAVE BEEN RECORDED

ARIZONA

*West of Hillside, Santa Maria Mtns., Yavapai Co.
West of Nogales, Ruby district, Santa Cruz Co.
*Patagonia Mountains, Santa Cruz Co.
*Lochiel, Santa Cruz Co.
*Huachuca Mountains, Cochise Co.
*Fairbank, Cochise Co.
One mile south of Apache Station, Cochise Co.
*40 mi. N Clifton, Greenlee Co.
*Between Mormon Flat and Apache Junction, Maricopa Co.
*Rincon Mountains, Pima Co.
*Santa Rita Mountains, Pima Co.
*Near Mount Fagan, Santa Rita Mountains, Pima Co.

NEW MEXICO

*25 mi. SE Animas, Hidalgo Co.
*Cloverdale country, Hidalgo Co.
West fork of the Gila River, near Heart Bar ranch, Gila National Forest.
30 to 40 mi. N Silver City, Hidalgo Co.

TEXAS

**Brownsville region, Cameron Co.
Eagle Pass, Maverick Co.
Boquillas, Brewster Co.

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*Taylor (1934)
**Bailey (1905)

LITERATURE CITED

BAILEY, V. 1905. Biological survey of Texas. North Amer. Fauna, no. 25, p. 192.
———— 1931. Mammals of New Mexico. North Amer. Fauna, no. 53, p. 347.
TAYLOR, W. P. 1934. The coati added to the list of United States mammals. Jour. Mamm., vol. 15, pp. 317–318.

Department of Wild Game, Agricultural and Mechanical College of Texas, College Station, Texas.

RELATIONSHIPS BETWEEN THE WOOD-MOUSE AND THE COTTON-MOUSE IN EASTERN VIRGINIA

BY LEE R. DICE

The wood-mouse (*Peromyscus leucopus*) is closely related to the larger cotton-mouse (*P. gossypinus*) and both are placed by Osgood (1909: 29) in the same species group. In the lower Mississippi Valley the ranges of the two species overlap broadly, but in the Atlantic states they come into contact only slightly (Osgood 1909, p. 29, and figs. 2–3). In the laboratory the wood-mouse and the cotton-mouse will cross and both the male and female hybrid offspring are fully fertile (Dice, 1937a; pp. 2–3). It has therefore seemed important to examine carefully the mice of the Dismal Swamp region of Virginia, where both species occur, to determine whether or not there is any evidence of hybridization between them in that area.

A grant from the Faculty Research Fund of the University of Michigan for the support of the field work is gratefully acknowledged. To Don Hayne, Paul A. Moody, and H. B. Sherman thanks are due for the collection of certain breeding stocks. The map was drawn by Grace Eager.

All the mice taken in the field were shipped alive to the Laboratory of Vertebrate Genetics at the University of Michigan, where they were kept under uniform conditions and fed a standard ration. Many of these field-caught animals were used for breeding. All of them, except a few that died in the cages, were later, in the spring of the year, prepared in a uniform manner as specimens. The laboratory-bred mice were kept to an approximate age of one year, when they, also in spring, were prepared as specimens.

The external measurements of the animals, freshly killed by ether, were taken by myself. The measurements of the bones and the tint photometer readings of the flat skins were made by various assistants according to standard methods (Dice, 1932: 5–7, 9, 22). The statistical computations are by Merrel A. Taylor. Standard errors rather than probable errors are employed throughout this paper. Differences between two means greater than about 2.7 times the standard error of their difference are here considered to be statistically significant.

The term stock, as used by me, designates the field-caught animals from a particular locality, together with their laboratory-bred descendants. In the production of the laboratory-bred animals here described there has been no in-breeding. The following stocks were employed in the study:

Cypress Chapel.—The trapping stations were located along the edge of Cypress Swamp, near Cypress Chapel, Nansemond County, Virginia. I trapped here in early September, 1933, and Don Hayne trapped in the same general location during January and February, 1935.

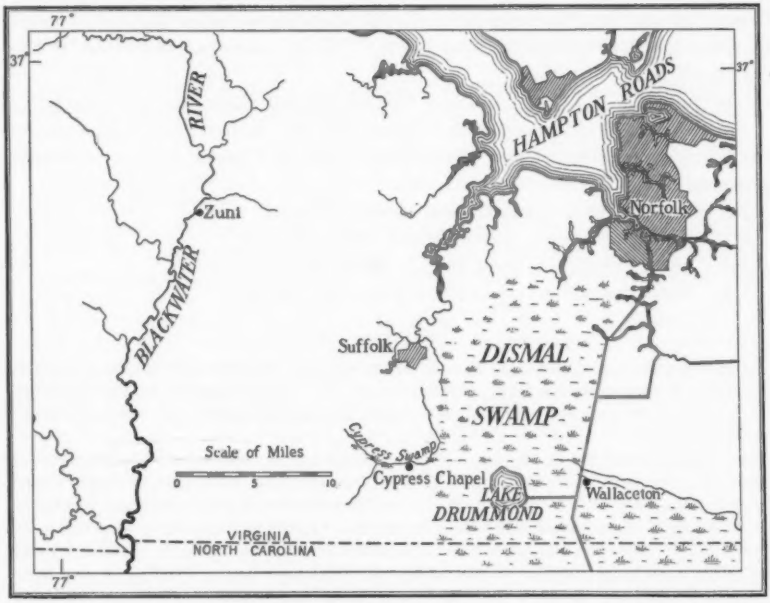

FIG. 1. Map of the Dismal Swamp region, Virginia, showing the localities described in this report.

Lake Drummond.—Trapping was conducted for one night only, in early September, 1933, in Dismal Swamp, near the northwestern shore of Lake Drummond, Nansemond County, Virginia.

Suffolk.—Two *leucopus* were taken September 4, 1933, in deciduous forest at the northeastern limits of Suffolk, Nansemond County, Virginia. One of the animals soon died, and no laboratory-bred offspring were obtained.

Zuni.—Trapping was conducted for one night only in late August, 1933, along the edge of the swamp bordering Blackwater River, just north of the village of Zuni, Isle of Wight County, Virginia.

Gainesville.—In February, 1933, we received from H. B. Sherman 15 *gossypinus* taken by him in a sweet gum swamp near Newnan's Lake, not far from Gainesville, Alachua County, Florida.

Sebring.—Our stock was derived from 8 mice taken by Paul A. Moody at Sebring, Highland County, Florida, in September, 1932.

The families here described are each the offspring of a single pair of mice. The parents of all the families, except one, were field-caught animals. In my system the mother is designated by a letter and the father by a number, and the family designation is accordingly a letter and a number. The members of several families were crossed with members of other families, several matings, usually reciprocal, being made. These crosses are indicated by the combined family symbols.

The following families from the Dismal Swamp region were produced:

A101. Mother *leucopus* from Cypress Chapel; father born in laboratory from female pregnant when captured at Cypress Chapel, but no specimen preserved.

B2. Both parents *leucopus* from Cypress Chapel.

C3. Both parents *gossypinus* from Cypress Chapel.

D4. Both parents *leucopus* from Lake Drummond.

E5. Both parents *leucopus* from Lake Drummond.

HABITATS

The vegetation of the Dismal Swamp region was well described by Kearney in 1901, but much of the swamp has since been lumbered. At no place seen by me in the swamp do the trees make a closed canopy, but sunlight reaches the water or the underbrush at many spots.

An indication of the shade density in the virgin swamp was secured by means of a Model 617 Weston exposure meter. The patches of apparently densest shade under large trees were selected and the amount of light determined by pointing the photo-electric cells (2 in my instrument) directly upward. In the swamp within a quarter-mile of Lake Drummond no reading of less than 70 foot candles was secured, with bright sun and with some large cumulus clouds in the sky. At the edge of Cypress Swamp near Cypress Chapel the shade under some large trees was slightly more dense and one reading of 35 foot candles was secured. In the openings between the trees the sunlight is of full or nearly full strength, too intense for the maximum capacity (1300 foot candles) of the meter.

A wide diversity of habitats is inhabited both by *leucopus* and by *gossypinus* in Tennessee (Kellogg, 1939, pp. 279–281) and also in Alabama (Howell, 1921, pp. 46–50). In Alabama, however, Howell notes that *leucopus* "is not so fond of the swamp bottomlands as its relative, the cotton mouse," *gossypinus*.

Of 8 animals taken by me at the edge of the swamp along Blackwater River near Zuni, Virginia, 4 are *leucopus* and 1 *gossypinus*, while 3 died and were not preserved as specimens. In upland brush and hard woods near Suffolk, Virginia, small mammals were evidently rare and only two mice, both *leucopus*, were taken in 64 traps. In an open forest of pine and oak 8 miles west of Suffolk no small mammals of any kind were taken in one night's trapping with 69 traps. At the edge of Cypress Swamp, near Cypress Chapel, Don Hayne and I secured a total of 37 mice, of which 5 are *leucopus*, 30

are *gossypinus*, and 2 are not available as specimens. Near the shores of Lake Drummond, in the midst of the Dismal, I secured 7 mice, of which 4 are *leucopus*, 2 are *gossypinus*, and 1, probably *gossypinus*, died, but was not prepared as a specimen.

At no place in the Dismal Swamp region did we find either species numerous, and in some apparently suitable upland habitats both species are rare or absent. From the 2 *leucopus* taken in upland woods at Suffolk one might suspect that this species prefers a somewhat drier habitat than *gossypinus*, but this is controverted by the presence of *leucopus* in some numbers in the midst of the Swamp at Lake Drummond.

That the occurrence of *leucopus* in the midst of the Dismal Swamp is not a recent development, correlated with the extensive lumbering operations, is demonstrated by the fact that in the years from 1895–1898 collectors for the United States Biological Survey took at Lake Drummond 22 specimens of *leucopus* and 8 of *gossypinus*, and at Wallaceton, in the eastern part of the Swamp, 15 *leucopus* and 5 *gossypinus*. This information was kindly furnished by A. H. Howell.

It is certain, therefore, that in swampy types of habitat in the Dismal Swamp region *leucopus* and *gossypinus* often occur together.

VARIATION IN SIZE

The Dismal Swamp family having the largest size, both in external dimensions and in skeletal parts, is C3. For no measurement is the C3 family exceeded significantly by any other family or stock. Furthermore, the means of the C3 family for body length, hind foot length, femur length, mandibular length, condylo-premaxillary skull length, and condylo-zygomatic distance are all significantly higher than those of every other here described family and stock.

The two Florida stocks, Gainesville and Sebring, both being *P. gossypinus*, rank next below the C3 family in most measurements. Only in tail length do they rank small. In ear length neither of these two stocks is significantly exceeded by the C3 family, and the Gainesville stock does not differ significantly from that family in bullar width of skull, but in all other measurements both Florida stocks are significantly exceeded by the C3 family. The Gainesville stock significantly exceeds the Sebring stock in ear length, length of mandible, and bullar width of skull, but in the other measurements the two Florida stocks do not differ significantly from one another.

The smallest dimensions are possessed by the Zuni stock, which must therefore be assigned to the species *leucopus*. In ear length the Zuni mice rank intermediate, but in every other measurement this stock has the lowest mean of all those here described; and in body length, length of mandible, condylo-premaxillary skull length, and distance from condyle to front edge of zygoma the Zuni stock averages significantly smaller than any other family or stock.

The several families B2, D4, and E5 (but not including C3), descended from field-caught Dismal Swamp parents assigned to *leucopus*, are somewhat intermediate in size between the C3 family and the Zuni stock. The D4 family, however, does not differ significantly from the C3 family in tail length. In ear length neither the B2 nor D4 families differ significantly from the Zuni stock, and both these families and also the Zuni stock significantly exceed the E5 family in this measurement. In femur length the Zuni stock is not significantly smaller than the B2 family, and in bullar width of skull the Zuni stock does not differ significantly from the E5 family.

The larger size in some measurements of the Dismal Swamp *leucopus* families than the Zuni stock of the same species is not believed to indicate an approach of these families toward the characters of *gossypinus*. *P. gossypinus* and *P. leucopus* occur together at Zuni, just as they do in the Dismal Swamp, with no indication of intergradation.

Crosses of the E5 family with the B2 and D4 families produced offspring which in

general are intermediate between the parent families. In several measurements the offspring average significantly larger or smaller than one or other of the parent families, but the differences are not very great.

A cross between the *leucopus* B2 family and the *gossypinus* C3 family resulted in offspring which also in general are intermediate between the two parent families. The offspring are intermediate and differ significantly from both parent families in hind foot length, femur length, length of mandible, condylo-premaxillary skull length, condylo-zygomatic distance, and bullar width of skull. In body length and tail length the B2 × C3 offspring are significantly smaller than the C3 family, but they do not differ significantly from the B2 family. In ear length they do not differ significantly from either the B2 or C3 families.

The considerable difference in certain measurements between adult wood-mice and adult cotton-mice makes discrimination between the two species fairly easy. Immature individuals are, it is true, often difficult or impossible to identify, but all the mice here described were kept in the laboratory long enough to make sure that they had reached adult size.

VARIATION IN PELAGE COLOR

The specimens of each of the Florida stocks, Sebring and Gainesville, are nearly uniform in pelage color, though the two stocks differ somewhat from one another. The Dismal Swamp mice, on the contrary, are moderately variable both in shade of color and in hue. Some Dismal Swamp specimens have a rich red buff tone, while others are very dark gray, with only a tinge of buff.

In tint photometer readings of the dorsal stripe the Sebring stock significantly exceeds the Gainesville stock for all color screens. The Sebring stock, therefore, on the dorsal stripe, is the paler of the two stocks. In readings of the side of the body, however, there are no significant differences between the two for any color screen.

The color differences between the several families of *leucopus* and *gossypinus* from the Dismal Swamp region are not very great, and Osgood (1909, p. 137) has pointed out that the two species cannot be distinguished on the basis of color alone.

The C3 family, which undoubtedly is *gossypinus*, ranks among the paler Dismal Swamp families in tone of the dorsal stripe, and its tint photometer readings are significantly exceeded only by the A101 family and then only for red. In tone of the side, on the contrary, the C3 family ranks among the darker families, and its tint photometer readings significantly exceed only the Zuni stock for green.

The families from the Dismal Swamp region which are assigned to *leucopus* show considerable variation in mean tint photometer readings, both for the dorsal stripe and for the side of the body. The extremes are, however, not very far apart, and only a few of the differences between the families are statistically significant.

The absence of any consistent difference in pelage color between the species *leucopus* and *gossypinus* makes it impossible to use pelage color as a character for discriminating between the two species in the Dismal Swamp region.

TAXONOMIC RELATIONSHIPS

The skulls of the field-caught *Peromyscus leucopus* (Rafinesque) from the Dismal Swamp region are in general smaller, but with the rostrum proportionately heavier and the width across the nasals at the tip of the muzzle actually wider than in *P. gossypinus* (Le Conte) from the same region. The *leucopus* skulls, however, vary considerably among themselves, and some specimens which undoubtedly belong to this species do not differ in their proportions from undoubted *gossypinus*. The *gossypinus* skulls also vary in their proportions, and, accordingly, it is impossible to separate the two species satisfactorily by the proportions of the skull.

In spite of the lack of qualitative differences between the species *leucopus* and *gossypinus* the two can be separated readily, in the Dismal Swamp region, when adult, by their difference in size. The most important measurement for discriminating between the species is hind-foot length. Every one of the field-caught Dismal Swamp *gossypinus* exceeds in size of foot every one of the field-caught *leucopus*. In other words, for this character there is no overlapping of the measurements of the two species. The molar teeth of *gossypinus* also are obviously larger than those of *leucopus*, but no measurements of the teeth were made. There are important differences between the field-caught adults of the two species in body length, ear length, mandibular length, skull length, condylo-zygomatic distance, and bullar width of skull (Tables I and II), but in each of these measurements there is some overlapping of the curves. There seems to be no important difference in tail length between the field-caught adults of the two species in this region. Femur length was not compared because of the few femurs of *leucopus* available for measurement.

The largest and heaviest skull among the field-caught *gossypinus* is that of the female which was the mother of the C3 laboratory-bred family. Although the teeth are not greatly worn her skull exceeds all the others in size. The large size of this female may account for some of the large size of the C3 family, the father of which has a skull of average size for *gossypinus*.

The male who was the father of the D4 family has a skull which is rather large for *leucopus*, but small for *gossypinus*. The teeth are small and the other measurements are those of *leucopus*, to which species the specimen is assigned.

There is an exceptionally large skull among the offspring of the D4 × E5 family cross. This skull is from a female killed when she was 38 weeks of age. It compares in size with the skulls of the C3 *gossypinus* family, but the cranium is more inflated and the bullae are proportionately larger. It is not at all similar in shape to the skulls of the other members of the D4 × E5 cross, which are assigned to *leucopus*. Although the measurements of the skull and of the femur are large, the external body measurements and the length of mandible of this animal are not exceptional for the family cross. This particular skull is consequently considered to be pathological.

The wood-mice of the Dismal Swamp region are assigned by Osgood (1909, p. 117) to the subspecies *Peromyscus leucopus leucopus*, which is said to average slightly smaller and darker than the subspecies *noveboracensis*. In their dimensions of body and skeleton, however, the wood-mice of the Dismal Swamp region show conflicting trends. Compared to the stocks of *noveboracensis* previously described from the northeastern United States (Dice, 1937b, table III) and from New England and Nova Scotia (Dice, 1939, table II) the Zuni stock averages small in most dimensions of body and skeleton. In particular the tail in the Zuni mice is much shorter than in any previously described stock. On the other hand, in ear length the Zuni stock averages longer than any previously described stock except the Kedgemakooge, Nova Scotia, stock, from which it does not differ significantly.

The generally small size of the Zuni mice, except for ear length, might be considered to indicate a trend in this region toward the small size said to be characteristic of the subspecies *leucopus*. The several families of Dismal Swamp wood-mice, however, fail to support this indication. The means of most of these Dismal Swamp families fall within the range of variation of the previously described stocks of *noveboracensis*, but tend to be rather large. For certain measurements the means of one or other of the Dismal Swamp families are higher than the highest previously reported *noveboracensis* mean of a comparable series. The considerable differences in dimensions between the Zuni stock and the several Dismal Swamp families is only another illustration of the considerable amount of local variability which these mice exhibit (Dice, 1937b, pp. 17–20).

TABLE I.—*Body dimensions of Peromyscus leucopus and P. gossypinus*
Means and standard errors, in millimeters

STOCK OR FAMILY	NO.	MEAN AGE IN WEEKS	NO. OF PARENTS	BODY LENGTH	TAIL LENGTH	FOOT LENGTH	EAR LENGTH
Laboratory-bred							
Virginia							
Dismal Swamp							
A101	12	47	2	94.58±1.06	72.60±0.87	20.067±.162	17.367±.119
B2	16	48	2	100.19±1.02	76.92±0.75	20.675±.119	17.819±.145
B2 × C3	12	45	4	103.67±1.10	76.75±1.47	22.075±.181	18.167±.228
B2 × E5	18	58	8	100.20±0.89	78.60±1.03	20.817±.165	16.965±.123
C3	23	59	2	112.65±0.88	84.95±1.25	24.378±.116	18.435±.116
D4	21	58	2	101.19±0.86	83.24±0.75	21.667±.139	17.438±.114
D4 × E5	17	51	6	100.06±0.86	77.56±1.33	20.912±.123	16.777±.103
E5	18	57	2	98.50±0.70	78.59±0.62	21.144±.111	16.911±.107
Zuni	22	50	4	90.82±0.75	68.36±0.83	19.936±.148	17.477±.133
Florida							
Gainesville	68	57	7	108.34±0.64	70.36±0.57	22.893±.073	18.450±.074
Sebring	81	47	8	107.44±0.46	70.26±0.50	22.614±.069	18.070±.078
Field-caught							
Dismal Swamp							
leucopus	9	—	—	95.22±1.63	81.11±2.37	20.289±.262	17.467±.263
gossypinus	32	—	—	105.81± .80	79.00±1.21	23.510±.108	19.183±.126

TABLE II.—*Skeletal measurements of Peromyscus leucopus and P. gossypinus*
Means and standard errors, in millimeters

STOCK OR FAMILY	LEFT FEMUR	LEFT MANDIBLE	CONDYLE-PREMAXILLA	CONDYLE-ZYGOMA	BULLAR WIDTH
Laboratory-bred					
Virginia					
Dismal Swamp					
A101	16.742±.149	17.000±.119	24.964±.164	18.158±.115	10.842±.042
B2	16.544±.131	17.194±.100	26.150±.159	18.813±.081	11.267±.058
B2 × C3	17.927±.212	17.745±.105	27.046±.200	19.309±.138	11.636±.061
B2 × E5	17.277±.179	17.083±.121	25.922±.122	18.761±.105	11.017±.058
C3	19.604±.096	18.548±.117	27.950±.119	20.070±.090	11.896±.127
D4	17.200±.133	16.990±.067	25.891±.114	18.648±.084	10.967±.031
D4 × E5	17.250±.175	17.229±.095	25.929±.193	18.629±.127	11.129±.102
E5	17.641±.123	17.206±.078	25.861±.084	18.622±.080	10.817±.040
Zuni	16.232±.132	15.886±.078	24.040±.131	17.305±.085	10.777±.030
Florida					
Gainesville	18.570±.100	17.588±.048	26.657±.078	19.100±.061	11.857±.036
Sebring	18.530±.102	17.361±.049	26.684±.082	19.173±.063	11.531±.030
Field-caught					
Dismal Swamp					
leucopus	16.300	16.800±.121	25.456±.294	18.533±.205	11.067±.080
gossypinus	18.625±.144	17.721±.122	26.861±.155	19.436±.107	11.600±.043

In pelage color the wood-mice of the Dismal Swamp region, when compared with the previously described stocks of *noveboracensis*, tend to be dark. On the dorsal stripe they are not very different from the darkest of the previously described stocks of *noveboracensis*. On the side of the body, however, the Zuni stock and all the Dismal Swamp families have, for most color comparisons, significantly lower tint photometer readings than any previously described stock.

TABLE III.—*Pelage color of Peromyscus leucopus and P. gossypinus*

Mean tint photometer readings and standard errors of laboratory-bred 1-year age class

STOCK OR FAMILY	DORSAL STRIPE		
	Red	Green	Blue-violet
Virginia			
Dismal Swamp			
A101	7.92±.17	4.92±.23	3.17±.16
B2	7.13±.35	4.87±.19	3.13±.12
B2 × C3	6.25±.27	4.42±.19	3.00±.12
B2 × E5	6.89±.27	4.50±.18	2.89±.11
C3	6.78±.24	4.61±.12	3.30±.10
D4	6.39±.29	3.95±.06	2.62±.17
D4 × E5	6.23±.30	4.12±.22	2.82±.17
E5	6.06±.29	3.83±.21	2.56±.16
Zuni	6.27±.27	4.14±.19	2.73±.17
Florida			
Gainesville	5.69±.15	4.07±.10	2.97±.12
Sebring	6.49±.16	4.76±.11	3.45±.09
	SIDE OF BODY		
Virginia			
Dismal Swamp			
A101	17.75±.44	10.33±.36	6.17±.23
B2	16.75±.29	10.56±.15	7.00±.09
B2 × C3	15.25±.35	9.83±.27	6.42±.22
B2 × E5	14.39±.45	9.50±.36	6.17±.24
C3	15.17±.32	9.70±.19	6.04±.16
D4	17.05±.49	10.00±.29	6.05±.21
D4 × E5	16.47±.36	9.59±.17	6.06±.15
E5	15.39±.21	9.56±.21	5.89±.19
Zuni	14.41±.47	8.68±.23	5.55±.17
Florida			
Gainesville	15.27±.21	9.93±.15	6.76±.10
Sebring	15.33±.22	10.28±.13	7.21±.09

The dark pelage color, especially for the side of the body, of the wood-mice of the Dismal Swamp region, compared to those from other localities in the northeastern United States and Nova Scotia, probably is correlated with the large amount of accumulated humus in the Dismal Swamp habitats. This humus produces a very dark soil color, which the small terrestrial mammals tend to match (Dice and Blossom, 1937, pp. 106–108).

On the basis of their pelage color, but not on their size, the wood-mice of the Dismal Swamp region are correctly assigned to the subspecies *leucopus*.

Two stocks of the species *Peromyscus gossypinus* are available from Florida, the Gainesville stock coming from within the range of the subspecies *gossypinus* and the Sebring stock from the range of the subspecies *palmarius*. The Gainesville stock significantly exceeds the Sebring stock in ear length, length of mandible, and bullar width of skull, but in other measurements the two stocks do not differ significantly. In pelage color the Sebring stock is paler on the dorsal stripe than the Gainesville stock, the tint photometer readings being significantly higher. In color of the side of the body there is, on the contrary, no significant difference between the stocks. These differences between the Gainesville and Sebring stocks agree reasonably well with the statement of Osgood (1909, p. 139) that *palmarius* averages smaller and paler than *gossypinus*.

The subspecies *gossypinus* also occurs in the Dismal Swamp region, but the only mice of this species of the one-year age class available for comparison with the Gainesville stock are those of the C3 family. Because these are all the descendants of a single pair of field-caught mice they do not fully represent the population at Cypress Chapel where their parents were taken. Both the C3 family and also the field-caught *gossypinus* from the Dismal Swamp differ significantly in certain measurements from the Gainesville stock, but, because these mice are not strictly comparable, no conclusions can be drawn as to possible differences between the mice of the two localities.

DISCUSSION

All the *Peromyscus* caught in the Dismal Swamp region and reared to maturity in the laboratory are clearly separable into two species. All are without question either *leucopus* or *gossypinus* and no specimen is intermediate in its characters. There is consequently no evidence that hybridization between the two species occurs in the Dismal Swamp region, even though both species at times occupy the same habitats and are taken on the same trap lines.

Osgood (1909, p. 137) was unable to find evidence of intergradation between the cotton-mouse and wood-mouse, but A. H. Howell (1921, p. 50) believes that two specimens from Alabama are probably hybrids. If these specimens actually are hybrids, crossing between the two species does occur sometimes in nature, but it must be very rare.

The lack of interbreeding between the species *leucopus* and *gossypinus* in the Dismal Swamp region must be based on an isolating mechanism (see Dobzhansky, 1937: 228–258) of some sort. When mated in the laboratory the two species, both those from the Dismal Swamp region and those from more widely separated localities, breed and produce fully fertile offspring. In nature the two species often occur in the same habitats. It is accordingly necessary to assume a psychological difference of some sort in the normal breeding behavior of the two species. Otherwise the two would soon merge at the places where they come into contact.

SUMMARY

In the Dismal Swamp region of Virginia *Peromyscus leucopus* and *P. gossypinus* frequently occur together in the same habitats. In the laboratory these species hybridize and produce fertile offspring. There is, however, no evidence of hybridization in nature in the Dismal Swamp region.

LITERATURE CITED

Dice, Lee R. 1932. Variation in a geographic race of the deer-mouse, *Peromyscus maniculatus bairdii*. Occ. Papers Mus. Zool. Univ. Mich., no. 239, pp. 1–26, 1 fig.

1937a. Fertility relations in the *Peromyscus leucopus* group of mice. Contrib. Lab. Vert. Gen. Univ. Mich., no. 4, pp. 1–3.

1937b. Variation in the wood-mouse, *Peromyscus leucopus noveboracensis*, in the northeastern United States. Occ. Papers Mus. Zool. Univ. Mich., no. 352, pp. 1–32, 1 map, 2 figs.

1939. Variation in the wood-mouse, *Peromyscus leucopus*, from several localities in New England and Nova Scotia. Contrib. Lab. Vert. Gen. Univ. Mich., no. 9, pp. 1–16, 1 map.

Dice, Lee R., and Philip M. Blossom. 1937. Studies of mammalian ecology in southwestern North America, with special attention to the colors of desert mammals. Carnegie Inst. Wash., Publ. 485, iv + 129 pp., 8 pls., 8 figs.

Dobzhansky, Th. 1937. Genetics and the origin of species. New York: Columbia Univ. Press. xvi + 364 pp., 22 figs.

Howell, A. H. 1921. A biological survey of Alabama: I, physiography and life zones; II, the mammals. U. S. Bur. Biol. Surv., North Amer. Fauna no. 45, pp. 1–88, 11 pls., 10 figs.

Kearney, Thomas H. 1901. Report on a botanical survey of the Dismal Swamp region. Contrib. U. S. Nat. Herb., vol. 5, no. 6, pp. i–x, 321–550, 13 pls., 40 figs., 2 maps.

Kellogg, Remington. 1939. Annotated list of Tennessee mammals. Proc. U. S. Nat. Mus., vol. 86, pp. 245–303.

Osgood, Wilfred H. 1909. Revision of the mice of the American genus Peromyscus. U. S. Bur. Biol. Surv., North Amer. Fauna, 28, pp. 1–285, 8 pls., 12 figs.

University of Michigan, Ann Arbor, Michigan.

NOTES ON A BLACK-FOOTED FERRET RAISED IN CAPTIVITY

By Shaler E. Aldous

While studying gassing operations on prairie dogs near Agua Fria, New Mexico, on July 10, 1929, I captured a young black-footed ferret (*Mustela nigripes*). The animal was successfully raised and kept in captivity for 5 months.

The area where the prairie dog control work was being conducted is in the north central part of New Mexico at an altitude of 8,000 feet. The holes of the prairie dog (*Cynomys gunnisoni zuniensis*) were treated with carbon bisulphide and then exploded in order to force the poisonous gases into all parts of the burrows. Each hole was covered with dirt immediately after treatment to confine the fumes, and also to indicate success by the number of holes remaining closed. About half an hour after treatment, the holes were examined to determine whether any of those gassed had been re-opened. Suddenly, about 25 feet in front of us, an adult black-footed ferret dashed into a hole with one of its young in its mouth. We hurried to the spot in time to stop the adult from taking the second young, which was about 5 feet from the opening of the burrow. As we stood beside the young one, the adult ferret rushed to the opening of the hole about six times, each time challenging us with a chattering scold. These ruses ended at the opening of the burrow.

After this series of challenges, it retreated into the burrow and did not again reappear, although we waited for fully 5 minutes. The young one taken was a female, light tan in color, and with its eyes open. It gradually turned darker until, when about half-grown, it was colored like an adult.

Food.—The first food offered the infant was diluted condensed milk, which she lapped up like a cat. Milk was the sole food given the first two days, and then a freshly shot prairie dog was placed in the box, more to get her reactions than with the thought that she would eat it. She paid no attention to it until the bloody part around the bullet hole was placed near her nose, then she grabbed it tenaciously and let go only after being forced to do so. The prairie dog was then opened and the ferret ate first the fatty portion of the greater omentum, then the liver and heart. After this meal, she slept for a long time. The next day a golden-mantled ground squirrel (*Citellus lateralis*) was offered to her with the result that she devoured all the internal organs except the stomach before she stopped eating. The following morning a young meadowlark was offered and she ate all the internal organs and some of the breast; in the afternoon she completely consumed a 4-inch minnow. She seemed to be particularly fond of fish. The next nine days, while I was in camp, she was fed a varied diet of fresh fish and small rodents.

On July 24 she was taken to Albuquerque, New Mexico, and confined in a cage on the back porch of my home. While there she was offered a wide assortment of food, all of which seemed to please her taste. The foods she ate readily included fish, birds, rodents, and also cottontail rabbit, calf liver, hamburger, fat pork (both raw and cooked) milk, and bread. After each meal the ferret cleaned her face by rubbing her nose in the sand, and then retired for a long sleep.

Cage.—The first artificial home provided was a small box with a piece of cloth in the bottom. Then a cage about one foot square was made and this was later replaced by a larger, double-compartment cage with a removable tin pan in the bottom for easy cleaning. Half of this new cage was covered so that only a small entrance hole permitted light to enter. When the new cage was completed, the ferret explored the opening to the dark compartment with caution and made several attempts to enter before she finally mustered enough courage to go in completely. After once entering she spent most of her time in that part of the cage. The dark compartment was always used as a retreat for eating and sleeping.

Sanitation.—The ferret's fur always appeared clean, although at no time was she ever seen washing herself in cat fashion. The fecal and urinal depositions were always made in one corner of the dark compartment of the cage, and sand was usually thrown on the accumulated waste. On a few occasions she was observed to dig a hole in the sand in the deposit corner, but many times the hole was missed and the excreta hit the side of the cage. The

tray was always filled with clean sifted sand after each cleaning, and the animal responded by rooting and rolling in it. Although a variety of substances were offered for bedding, the ferret always pushed them into the fecal corner along with rejected food material.

Reactions.—At first the ferret's movements were very awkward, but she soon became quite agile. She was exceedingly playful from the beginning and enjoyed being rubbed on the nose and belly. The latter treatment would always cause her to scratch and bite in a fashion identical to that of a small domestic kitten. A little verbal coaxing would usually induce her to come out of the dark chamber and smell my fingers, and oftentimes playfully bite them.

On August 7, she was lifted out of the cage and placed on the porch. At first she was very cautious and jumped and shied from every object encountered and bristled her tail to full capacity. Almost every new object, especially if it moved when touched, sent her hurrying back toward the cage. Gradually she became bolder and ventured farther and farther from the cage. In about 15 minutes she had explored all parts of the porch. In one corner was a large wooden box with a small crack near the bottom through which she entered; when inside, it was difficult to coax her out. After this first exploration she would beg to be let out by rearing on her hind legs and pushing the top of the cage with her nose. When the cage was opened she tried several times to climb over the top but fell back on each occasion. Finally she accomplished the task, after which she always climbed out without difficulty. The lid was left unfastened a few times and she learned to push it open and get out alone. It was then necessary to keep the top tightly fastened when she was not wanted loose on the porch. After becoming accustomed to freedom on the porch, she would take every opportunity to sneak up to one of our family and grab a pant's cuff or an exposed heel as we walked by. Her graceful leaps when she was free to run were beautiful to observe.

These escapades on the porch gradually eliminated her gentle attitude and she became saucy on being handled or put in the cage. It soon became necessary to use leather gloves when handling her as her biting ceased to be playful. About the first of December, the porch door was left open and the ferret escaped and took refuge in a large wood pile in the back yard. We had occasional glimpses of her around the yard but she always ran into the wood pile when we approached. All coaxing was of no avail in getting her to come out. After she had enjoyed three days of freedom, the cage was placed near the wood pile with the lid open and meat bait inside. We watched from a window and in a few minutes she came out and jumped into the cage. Carefully approaching from the blind side of the cage, I succeeded in closing the lid and she was again in captivity. The capture enraged her and she jumped and scolded much as her mother had done when the young one was caught.

She became so vicious after the sojourn in the wood pile that it was dangerous to handle her, so she was killed and made into a study skin. The measurements at time of death were: Total length, 401 mm.; tail, 91; hind foot, 51; and height of ear 14. The study skin is now in the Biological Survey's collection in the Food Habits Laboratory, Denver, Colorado.

U. S. Biological Survey, St. Paul, Minnesota.

NOTES ON THE POCKETED FREE-TAILED BAT

By Seth B. Benson

The pocketed free-tailed bat (*Tadarida femorosacca* Merriam), of the southwestern United States and northwestern Mexico, has been so poorly represented in museum collections that heretofore it has not been possible definitely to determine its systematic status. Shamel, the last reviser of the American members of the genus *Tadarida* (Proc. U. S. Nat. Mus., vol. 78, 1931, art. 19, pp. 1–27), apparently thought it probable that *femorosacca* was conspecific with *Tadarida laticaudata* Geoffroy, of Brazil and Paraguay, but was unable to reach a final decision because of the lack of specimens showing the color of *femorosacca* when adult. The only skin of *femorosacca* available to him was of an immature individual which differed in color from adults of *laticaudata*. This difference, which he thought might not be of systematic worth, was the only one he recognized between *femorosacca* and *laticaudata* in the limited material of *femorosacca* (8 alcoholics, 1 skin-and-skull) that was available to him for study.

A solution of this problem has been made possible by study of eleven specimens (9 skins-and-skulls, 2 alcoholics) recently collected one mile northwest of Alamos, southeastern Sonora, Mexico. These have been compared with specimens of *laticaudata* (6 skins-and-skulls, 1 alcoholic), from Sapucay, Paraguay, and with a skin-and-skull of *femorosacca* from Coyote Mountain, Arizona, in the collections of the United States National Museum.

The conclusion is that *femorosacca* and *laticaudata* are distinct species. Each has distinctive characters which do not intergrade, and neither is known to occur in the vast area (southern Mexico, Central America, and northern South America) which separates the known ranges of the two forms.

The two species are distinctly different in color. The dorsal color of *femorosacca* is duller and less reddish than in *laticaudata* and the tips of the hairs of the ventral surface are paler. To my eye the general color of the dorsal surface of *femorosacca* is sepia or olive-brown (technical color terms are those of Ridgway, Color Standards and Color Nomenclature, 1912) while that of *laticaudata* is mummy brown. There is but little difference in color between the adult specimens of *femorosacca* from Sonora and the immature specimen

from Arizona. The Sonoran specimens are slightly darker, and the hairs of the dorsal surface are longer and have more white at their bases. Probably the short hair and lack of basal white in the immature specimen indicates that it was collected when the hair had not yet completed its growth.

Although the specimens of *femorosacca* and *laticaudata* are alike in most external features, apart from color, they differ in some particulars. The thumb of *femorosacca* is shorter. The patagia of *femorosacca* bear fewer hairs and these are much finer and paler. This is especially evident on the proximal part of the lower surface of the uropatagium. Also the membranes of the ears of *femorosacca* appear to be thicker and more rugose. This is evident in the alcoholics as well as in the dried skins, but the thinner membranes of *laticaudata* may be the result of shrinkage during the long time they have been preserved. They were collected in 1901. The measurements recorded by the collectors indicate that in *femorosacca* the tail is longer; but it is possible that differences in the technique of measurement may account for this.

Compared with that of *laticaudata* the skull of *femorosacca* is longer, slightly less in occipital depth, has a longer and narrower rostrum, greater condylobasal length, longer maxillary toothrow, longer mandible, and longer mandibular toothrow. The margins of the anterior nares are prolonged to form a short tube (not present in *laticaudata*), the posterior border of the anterior nares is less emarginate, the lacrimal processes are less pronounced, the interorbital region is longer and more tubular, the lateral profile of the top of the skull is straighter, the supraoccipital is more inflated, the teeth are less crowded, the anterior lower premolar is relatively larger, the coronoid process is larger, more deflected, and is placed farther from the condyle, the angular process is larger, wider, more deflected laterally, and the lower margin of the ramus is straighter.

Measurements.—Average and extreme measurements in millimeters of *Tadarida femorosacca* (10 specimens from one mile northwest of Alamos, Sonora). Total length, 112 (98–118); tail, 46 (35–49); hind foot, 10 (9–10); ear from notch, 23 (21–24); ear from crown, 18 (17–18); weight in grams, 12.3 (10.7–14.0); head and body, 66 (62–70); tibia, 11.7 (11.0–12.6); forearm, 46.2 (44.8–47.0); third metacarpal, 46.5 (45.3–47.4); fifth metacarpal, 26.4 (24.9–27.6); thumb, 6.4 (6.1–6.7); second phalanx of fourth finger, 2.8 (2.3–3.8). *Skull* (8 specimens): Greatest length (not including incisors), 19.0 (18.2–19.3); zygomatic breadth, 10.5 (10.1–10.9); interorbital breadth, 3.7 (3.6–3.8); occipital depth, 6.4 (6.2–6.6); breadth of braincase, 8.9 (8.6–9.2); condylobasal length, 18.0 (17.3–18.2); length of maxillary toothrow, 7.3 (7.0–7.5); breadth across maxillary toothrows, 7.6 (7.2–7.9); breadth across canines, 4.3 (4.0–4.5); length of mandible, 12.9 (12.5–13.2); mandibular toothrow, 7.9 (7.6–8.2); width between lacrimal processes, 5.1 (4.8–5.4); posterior edge of infraorbital foramen to posterior border of frontals, 5.1 (4.9–5.5).

Measurements of *Tadarida laticaudata* (6 specimens from Sapucay, Paraguay): Total length, 107 (104–109); tail, 42 (40–42); hind foot, 10; head and body, 65 (64–67); tibia, 12.6 (11.8–13.0); forearm, 45.0 (43.0–46.7); third metacarpal, 44.7 (42.0–46.2); fifth metacarpal, 26.9 (26.5–27.1); thumb, 7.3 (6.7–7.9); second phalanx of fourth finger, 2.9 (2.6–

3.4). *Skull:* Greatest length, 17.9 (17.6–18.2); zygomatic breadth, 10.4 (10.1–10.6); interorbital breadth, 3.7 (3.5–3.9); occipital depth, 6.6 (6.4–6.9); breadth of braincase, 8.9 (8.7–9.1); condylobasal length, 17.1 (16.8–17.4); maxillary toothrow, 6.9 (6.8–7.0); breadth across maxillary toothrows, 7.7 (7.4–7.9); breadth across canines, 3.9 (3.7–4.2); length of mandible, 12.5 (12.2–12.8); mandibular toothrow, 7.4 (7.1–7.6); width across lacrimal processes, 5.3 (5.1–5.6); posterior edge of infraorbital foramen to posterior edge of frontal, 4.4 (3.8–4.6).

Margarito Delgadillo and I trapped the specimens of *Tadarida femorosacca* on April 24, 1939, at a pool of water above a sunken dam in an arroyo one mile northwest of Alamos. The pool was about twenty feet long, ten feet wide, and about a foot deep. It was much used as a drinking place by cattle, burros, and wild animals at the time of our visit, because the dry season was prevailing and surface water was scarce.

We found that the free-tailed bats arrived at the pool about an hour after sunset, when it was quite dark. They flew swiftly about the pool, making distinctly audible whistling and fluttering sounds with their wings as they maneuvered. Occasionally they squeaked and chattered shrilly. They drank while in rapid flight, hitting the surface of the water with a smacking sound and leaving ripples where they touched it with their muzzles.

We used the trapping method described by Borell (Jour. Mamm., vol. 18, 1937, pp. 478–480) whereby thin wires are stretched over the water. Because the bats usually flew lengthwise of the pool, we placed the wires across it, three feet apart and about an inch above the water. They were fastened to stakes driven in the sand at the edges of the pool.

After the trap was completed we waited in the darkness. The sound of wings fluttering during abrupt changes of direction announced the arrival of a bat. Occasionally we could see its dark form against the sky. Then followed a twang of the wire, a shrill protest from the bat, and a splash as the animal struck the wire and water. Then followed a quick pattering or flopping sound as the bat swam rapidly toward shore. This procedure was varied but little in our captures during the next two or three hours. We caught eleven *T. femorosacca* and two *T. mexicana*. A few escaped by taking off from the ground after reaching shore.

Nearly all the bats which struck the wire fell into the water, but occasionally we heard only a twang as a bat hit the wire and yet managed to continue on in its flight. According to my Mexican companion these bats were "*tocando el harpa*" (playing the harp).

Usually the bats began to swim as soon as they were in the water, but sometimes they waited a few seconds. They swam with a distinct bobbing motion, high on the water, using quick simultaneous strokes of their partly extended wings. They could not rise into the air from the water and seemed to turn all their attention to reaching some solid support. When seized from the rear while swimming, the bats did not attempt to bite until lifted from the

water, but when they were seized while on the ground they would quickly turn to bite and to protest shrilly.

The stomachs of the bats taken early in the night were well-filled, showing that only a short time is necessary for a bat to secure its first meal of the night. Five of the eleven specimens were females. Two of four which were dissected each contained one embryo.

University of California Museum of Vertebrate Zoology, Berkeley, Calif.

ACTIVITY AND FOOD CONSUMPTION IN MICROTUS AND PEROMYSCUS

By Donald M. Hatfield

A survey of the literature covering the field of mammalian activity, as it is evidenced under controlled conditions in the laboratory, quickly reveals that a great part of the research, whether in the fields of ecology, physiology, or psychology, has been conducted on those mammals common to every laboratory—the white rat, white mouse, and guinea pig. The reasons for this have obviously to do with expedience; stocks of these mammals can be maintained with a minimum of labor and space. It is suggested, however, that such results as have been obtained from experimental study of these mammals are in all probability colored by the very character that promotes their use as laboratory animals—toleration of confinement. It can hardly be expected that a white rat, restricted throughout its life by the walls of a cage no more than eighteen or twenty inches square, will present a picture of normal reaction when subjected to a given set of experimental conditions. This point is brought out by Richter (1927), who wrote that white rats, kept in large combination cages offering outlets for the drives of nest-building, running, feeding, drinking, climbing, gnawing, etc., display greater "intelligence" and activity than rats kept in standard laboratory cages.

It is felt, therefore, that laboratory study of wild mammals is of value, if for no other reason, for comparison with results obtained with these domesticated forms. In any event, the comparative study of wild mammal activity is of interest in itself, and when opportunity was afforded me to make such a study in the laboratories of the Division of Entomology and Economic Zoology of the University of Minnesota, two races of the family Cricetidae were chosen for observation. These were: *Microtus pennsylvanicus pennsylvanicus* (Ord), and *Peromyscus maniculatus bairdii* (Hoy and Kennicott). Emphasis was placed on the study of the former.

Of the relatively small amount of work that has been done with wild rodents, by far the greater part is concerned with activity only. Johnson (1926) demonstrated the typical nocturnal-diurnal rhythm of activity shown

by *Peromyscus maniculatus* and *P. leucopus*. Behney (1936), also working with *P. leucopus*, showed that the typical 24-hour rhythm might be destroyed in the winter when snow covers the ground. Davis (1933) discovered that the British *Microtus agrestis* is apparently chiefly nocturnal and has maxima of activity during the dawn and dusk hours. He also demonstrated a two- to four-hour rhythm in one individual. Hamilton (1937a) wrote that he had found *Microtus pennsylvanicus* to be active at all hours, and (1937a) offers field data, gathered over a period of four years, and involving the capture of over 4,000 meadow mice, in proof of the fact that mice of this genus are somewhat crepuscular.

METHODS AND MATERIALS

Standard ration.—Since it was planned, with the inception of this study, to correlate food consumption with activity, it became evident early that it would be necessary to establish a standard ration upon which the mice would thrive and which could be used throughout the experiment. At first, it was thought that the diet developed by Dice (1934) for *Peromyscus* could be used without alteration for *Microtus*. This diet was found, however, to be lacking in the roughage so necessary for the well-being of the meadow mouse, and, by inference, it has been suspected of containing too large a percentage of protein for the primarily vegetarian *Microtus*.

Many combinations of foods were tested; the diet finally selected as most satisfactory included most of the ingredients used by Dice (loc. cit.) except that roughage was added and fine sand was included for the reasons stated below. It comprised, in parts by weight:

Rolled oats	50	Sunflower seed	2
Dry meat scraps	10	Hemp seed	1
Dry alfalfa	20	Canary seed	1
Dry skim milk	5	Millet seed	1
Whole wheat	1	Iodized salt	1
Wheat germ	5	Fine sand	1
Cod-liver oil	2		100

A factor of primary importance in the feeding of meadow mice under experimental conditions is the continual growth of their teeth, both incisive and molariform, regardless of the amount of wear. Under ordinary conditions, in the wild state, this growth is balanced by the wear resulting from the siliceous content of much of the food of this species. However, unless some grinding agent is supplied for captive animals, the molariform teeth often grow to such lengths that mastication becomes a practical impossibility. It was for this reason that one part of fine sand was included.

With this diet, it was found that adult mice maintained weight, but did not become fat. It should be mentioned here that the mice would not breed

while on this diet; whether the food was the principal factor is open to question. The reserve cages, in which mice not actually under experimental conditions were kept, were situated in a greenhouse in which the temperature was maintained at between 10°C. and 15°C. McNair (1931) points out that *Peromyscus* seems not to breed well under greenhouse conditions, where the temperature is consistently higher than that out-of-doors for much of the year. It seems possible that the same may hold for *M. pennsylvanicus*. On the other hand I have found *M. californicus*, *M. montanus*, and *M. pennsylvanicus* to breed at room temperatures when given a diet consisting largely of bulky green foods. Probably, then, a deficiency of bulky green food in the present study may be considered the cause of non-breeding on the part of the meadow mice. It is felt that this lack is outweighed by the greater accuracy with which food consumption may be determined, and results from different mice or groups of mice compared. Maintenance of body weight is deemed an indication of well-being.

The food was presented to the mice in the dry form in round metal salve boxes 3 inches in diameter and 1¼ inches deep. In the top of each box a one-inch hole was punched, through which the mice obtained the food. There was very little wastage, and it is felt that an accurate record of food consumption, both comparative and absolute, has been kept in this study.

Water was provided by the drop method. No attempt was made to record amounts of water taken; rather, each mouse was provided with as much as it cared to drink. When an individual was subjected to temperatures of around 0°C., minor fluctuations frequently resulted in the freezing of the water column and sometimes breakage of the glass. Under such circumstances, it is possible that the mouse did not have sufficient water for short periods of time. This was in part obviated by placing a container of snow in the cage during the course of an experiment at this temperature.

In order to ascertain what might constitute "normality" with regard to amount of food consumed under cage conditions, twelve mice, in the reserve cages, were fed on the standard ration for a period of 22 days. Ten of these, *Microtus*, consumed an average of 3.48 grams of food per 24 hours. Two, *Peromyscus*, each consumed 3.01 grams per 24 hours.

As mentioned previously, this study was inaugurated in order to learn something of the relation of food consumption to activity in *Microtus* and to compare this relationship with that existing with *Peromyscus*. It was, therefore, necessary to devise activity cages which would record, specifically, the amount of activity exhibited by an individual in obtaining a certain amount of food. I have repeatedly observed that meadow mice, and to a lesser extent, white-footed mice, in captivity, obtain food by running from the nest-box to the food supply, eating a bit, then running back to the nest-box, to be out at the food-box again, sometimes within one or two minutes. It was to record this shuttling movement that the equipment was devised. It con-

sisted of a nest-box and a food chamber, connected by an enclosed recording tunnel. A mouse, running back and forth, tripped apparatus in the tunnel that marked horizontal lines on a paper disk. The disk was ruled off into twelve equal sectors and rotated by clockwork. Four such units were placed in operation under various conditions of temperature and light. Food consumption was recorded every 24 hours.

Carrier cabinets (see Chapman, 1931), large enough to accomodate two complete units, were used for temperature control. Experimental temperatures ranged from 0°C. to 35°C.

RESULTS

Microtus—activity.—It may well be stated at the outset that light seemed to have no effect whatever on the mice under observation. Even a complete reversal of normal day-lighting and dark nights to dark days and lighted nights was seen not to change the standard two- to four-hour rhythm of food-getting activity in *Microtus*. This seems to be in disagreement with the findings of Hamilton (1937a) and Davis (1933), and with my own general observations made at earlier date on another species (Hatfield, 1935).

Perhaps the most striking result in this series of studies was the demonstration of a two- to four-hour rhythm, at moderate temperatures (see fig. 1), similar to that recorded by *Microtus agrestis* in Davis' study and by *Rattus norvegicus* in the comprehensive study made by Richter (1927). It should be emphasized that the periods of activity are, or appear to be, based on the desire of the mice to obtain food.

Richter (1927) has demonstrated that the rhythm in the rat is directly related to, and probably caused by, periodic hunger contractions of the stomach. Man appears to experience the same reaction to hunger, for, according to Rogers and Martin (1927), there is a definite two-hour cycle of contraction in the stomach when it is empty. It seems doubtful that this apparent similarity between man and mouse is more than superficial, since, in *Microtus* at least, the metabolic rate is considerably higher than in man, and one two-hour period includes the complete cycle of hunger-ingestion-digestion-hunger.

At all temperatures, the different meadow mice exhibited similar, though not identical, food-getting action. This was most definitely shown at temperatures of 30°C. and 0°C. At temperatures of from 0° to 28°C., no matter what the conditions of lighting may have been, the rhythm was maintained. At 30° and up, however, the meadow mice seemed to become active nearly all the time; the rhythm was completely obscured. It seems probable that several factors may combine to force an individual to this hyperactivity. First, the mouse is in an atmospheric temperature which is near the lethal limit for this species. Under field conditions, *Microtus pennsylvanicus* inhabits areas well-shaded by grass, frequently moist, and consequently

cool. If, during the heat of the day, surface temperatures become high enough to cause discomfort, the mouse can, and usually does, retire to subsurface tunnels. It is unusual to obtain any results from diurnal trapping operations for these mice when the temperature stands much above 35°C.

A second factor in this speeding-up of activity may be directly concerned with hunger. As the metabolism of the mouse is increased, the rhythm is broken, because, since the individual is forced to be continually active, it also requires an almost continual flow of food to support this hyperactivity. Close observation showed this to be the case; a mouse, at temperatures of

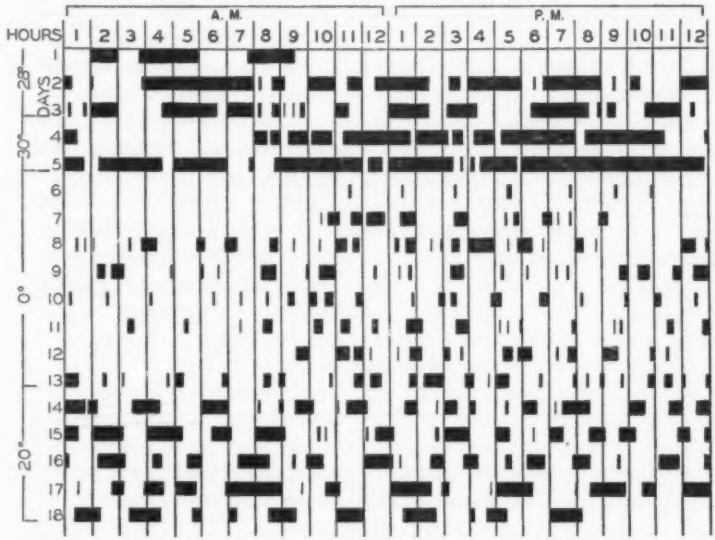

FIG. 1.—Food-getting activity in *Microtus pennsylvanicus*. One individual, 18 days

30°C. or above, would come out of the nest-box, eat a bit of food, perhaps drink some water, defecate or urinate or both or neither, retire to the nest-box, and be out to the feeding cage again within three or four minutes. This same type of behavior was to be seen at lower temperatures also, but only during one of the periods of activity, never continuously.

We have noted, then, two types of activity: the regular periodicity at 20°C., with an hour of action followed by an hour of quiescence; and the practically continuous activity of an individual subjected to 30°C. and higher. There is a third type, at 0°C., which shows a sketchy rhythm with long periods of inactivity interspersed with much shorter periods of positive activity. It

would appear that the shortness of these periods is due to the direct response of the animal in attempting to escape the cold.

In fig. 2 is presented graphically the percentage of time one individual was active, and the grams of food consumed at various temperatures. As indicated above, activity is seen to increase at high temperatures and to decrease at low temperatures. This is shown further by the averages that may be computed for activity of all four individuals at the various temperatures. Thus we find that, at 0°C., the meadow mice are active, on the average, but 16.0 percent of the time; at 20°C., they are active 30.5 percent of the time, and at 30°C., 56.8 percent of the time.

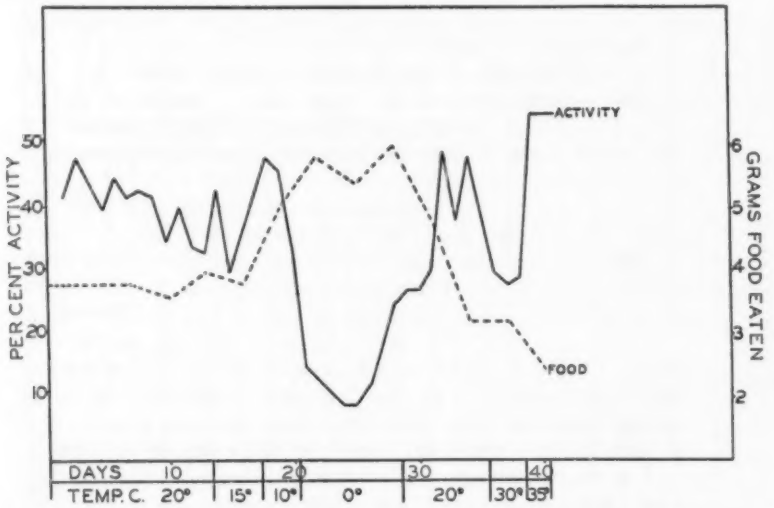

FIG. 2.—Food consumption and activity at various temperatures—*Microtus p. pennsylvanicus*.

Microtus—food consumption.—As might be expected, food consumption increases with lowering of temperature; the same phenomenon was observed by Chenoweth (1917) in *Peromyscus*. The same author mentions that, at high temperatures, less food is eaten; the same appears to be the case with *Microtus*. Inasmuch as activity is seen to increase so markedly at these higher temperatures, it might be thought that it would be necessary for the mice to eat a greater amount to sustain this activity. Apparently, however, this is not the case; it seems that, at lower temperatures, the mice eat more at a time than they do at higher temperatures, and observation proved this to be the case. An individual kept at 0°C. ate rapidly, taking little time to select any particular parts of the ration, and seemed to hurry back to the nest-

box, presumably to escape the cold. At 30°C., on the other hand, a mouse ate but a little at a time, and searched for preferred portions of the ration.

Peromyscus—activity.—Any periodicity of short span, such as shown above for *Microtus*, is completely secondary to the nocturnal-diurnal 24-hour rhythm exhibited by *Peromyscus* (see fig. 3). The white-footed mice studied in the present work seem not to show any shorter rhythm whatever, though the results from study of two individuals could hardly be considered conclusive

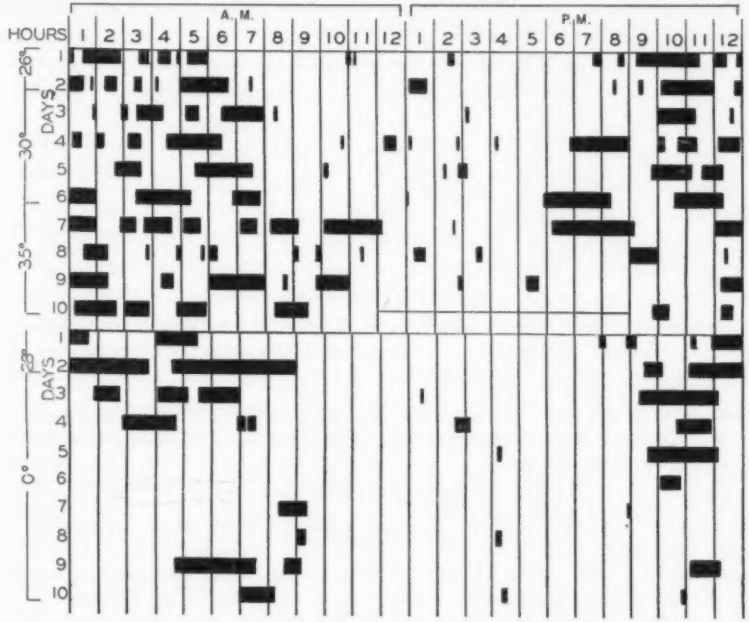

FIG. 3.—Food-getting activity in *Peromyscus maniculatus*. Two individuals, 10 days each.

in this regard. There is indicated, however, a strong suggestion that the 24-hour rhythm may be modified by high temperatures. The mice became active at intervals throughout the day and night when subjected to an atmospheric temperature of 35°C. On the other hand, as in *Microtus*, the daily rhythm in *Peromyscus* seems to be maintained at low temperatures, though the time actually spent in obtaining food is considerably shortened.

The *Peromyscus* studied here showed little correlation between temperature and food consumption, although one mouse ate less at high temperatures. Though perhaps of comparative worth, these results have little absolute significance.

SUMMARY

Meadow mice of the species *Microtus pennsylvanicus* showed a two- to four-hour rhythm of food-getting activity at temperatures of from 0° to 28°C.

This periodicity was obscured when the temperature was raised to 30°C. and above; the mice were then active nearly all of the time.

At 0°C., although the periodicity was maintained, the length of each term of activity was considerably shortened.

Consumption of the standard ration increased at lower temperatures and decreased at higher temperatures.

White-footed mice of the species *Peromyscus maniculatus* showed no rhythm other than a 24-hour, nocturnal-diurnal cycle; they were more active at night than by day.

Cold caused a decrease in activity and food consumption in this species; heat caused an increase in activity and a decrease in food consumption. The correlation was not well marked.

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LITERATURE CITED

BEHNEY, W. H. 1936. Nocturnal explorations of the forest deer-mouse. Jour. Mamm., vol. 17, pp. 225–230.

CHAPMAN, R. N. 1931. Animal Ecology, 464 pages. McGraw-Hill Book Co., Inc., New York.

CHENOWETH, H. E. 1917. The reactions of certain moist forest mammals to air conditions and its bearing on problems of mammalian distribution. Biol. Bull., vol. 32, pp. 183–201.

DAVIS, D. H. S. 1933. Rhythmic activity in the short-tailed vole, *Microtus*. Jour. Anim. Ecol., vol. 2, pp. 232–238.

DICE, L. R. 1934. An improved *Peromyscus* ration. Jour. Mamm., vol. 15, pp. 160–161.

HAMILTON, W. J., JR. 1937a. Activity and home range of the field mouse, *Microtus pennsylvanicus pennsylvanicus* (Ord.). Ecology, vol. 18, pp. 255–263.

———— 1937b. Growth and life span of the field mouse. Amer. Nat., vol. 71, pp. 500–507.

HATFIELD, D. M. 1935. A natural history study of *Microtus californicus*. Jour. Mamm., vol. 16, pp. 261–271.

JOHNSON, M. S. 1926. Activity and distribution of certain wild mice in relation to biotic communities. Jour. Mamm., vol. 7, pp. 245–277.

MCNAIR, G. T. 1931. The deer mouse, *Peromyscus*, a valuable laboratory mammal. Jour. Mamm., vol. 12, pp. 48–52.

RICHTER, C. P. 1927. Animal behavior and internal drives. Quart. Rev. Biol., vol. 2, pp. 307–343.

ROGERS, F. T., AND C. L. MARTIN. 1926. X-ray observations of hunger contractions in man. Amer. Jour. Physiol., vol. 76, p. 349.

Economic Zoology, University of Minnesota, St. Paul, Minnesota.

STUDIES ON THE MUSCLES OF THE HEAD, NECK, AND PECTORAL APPENDAGES OF GEOMYS BURSARIUS

By Edward Eugene Orcutt

The purpose of this study was to determine the manner and degree of muscular adaptations and adjustments in the head, neck, and shoulder regions of the pocket gopher *Geomys bursarius* (Shaw). The pocket gopher is a fossorial type of rodent that spends its entire existence in a subterranean environment, and in which it does a great deal of digging to form burrows. Thus, one would expect some sort of a change in the musculature of the body, especially in those muscles that aid in moving and piling soil.

In order to demonstrate what changes have occurred, it was decided that there should be some type of a terrestrial rodent with which the muscles of the pocket gopher could be compared. The white rat, *Mus norvegicus albinus* (Erxleben), was used because it is a more nearly generalized type of terrestrial rodent, having no particular specializations, approximating the pocket gopher closely in size, and of which an adequate supply of specimens was available.

The author wishes to express his sincere appreciation to all members in the Zoology Department of the University of Nebraska who have aided in making this paper possible, and for the use of equipment. Especial thanks are due to Dr. Otis Wade, under whose direction this problem was pursued.

Work on this problem was started in June, 1936, with the preparation of pocket gophers and white rats for dissection and study. Adult, well-developed individuals were selected and killed with chloroform and injected with an embalming fluid. The formula for this fluid includes ten parts of glycerine, two and five-tenths parts of phenol, and one and five-tenths of formalin. This stock solution was diluted one part to every four parts of water and injected into the animal. After sufficient injection, the animals were placed in a solution of ten per cent formaldehyde.

In making the dissections of the pocket gopher and the white rat the purpose was to reveal the origin and insertion of each muscle of both animals, and to note the differences of the homologous muscles. Dissections of the corresponding muscles were worked on simultaneously. The specimens were then dried and the dissected muscles outlined in black India ink. These muscles were then photographed, and lantern slides were made and projected on a sheet of drawing paper. The drawings of the muscles were made twice their natural size.

Among the reference books used as guides in illustrating and describing the muscles were: Anatomy of the Rat, by Greene (1935); Anatomy of the Wood Rat, by Howell (1936); Monographic revision of the pocket gophers, by Merriam (1895); Anatomical adaptations in the thoracic limb of the California pocket gopher and other rodents, by Holliger (1916). The terminology used here is based on the Basle Nomina Anatomica (B.N.A.) as set forth by

Eycleshymer (1917), and Greene (1935) who followed Emmel's 1917 edition of the B.N.A.

In August, 1937, John Eric Hill's study of the genus *Thomomys* was published. Marked differences of any kind between *Thomomys* and *Geomys* have been incorporated in this paper.

Muscles

M. temporalis (tem., figs. 1, 2, 3, 16, 17). This muscle occupies the whole of the upper surface of the cranium behind the orbits. It covers the parietal, squamosal and the posterior part of the frontal bone as far forward as the postorbital prominence.

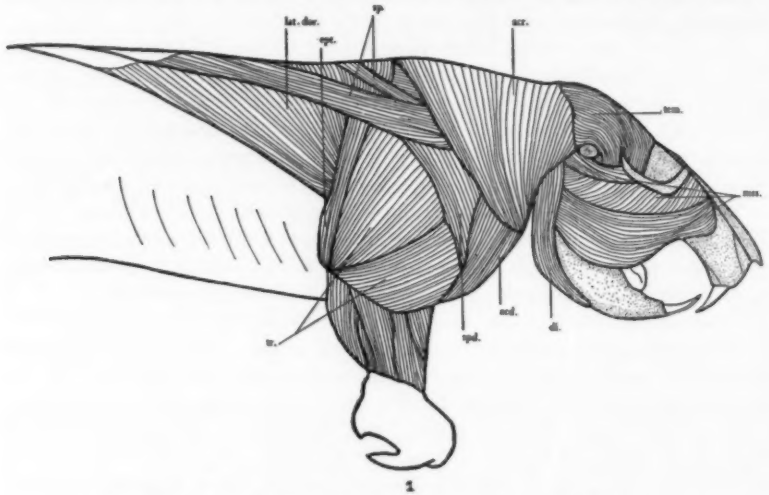

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Fig. 1. View of the right side of gopher showing superficial muscles

It arises from the flat upper surfaces of the bones named above and from the lambdoidal and sagittal crests. It is divided into two parts: superficial, which inserts into the apex, posterior edge, and inner side of the coronoid process of the mandible; and deep, inserted by a dense aponeurosis on the anterior edge of the basal half of the coronoid ramus, posteriorly. The muscle remains fleshy and covers the inner side of the coronoid ramus where its insertion extends downward to the bottom of the deep pit between the ramus and the posterior molar. This muscle is much more developed in the gopher, especially in width and thickness.

M. masseter (mss., figs. 1, 2, 16, 17). This muscle was checked several times with the results of Merriam's work on the muscles of the head of *Geomys bursarius*. Merriam (1895) divided the muscle primarily into three parts: (1) Superficial or rostral part, whose origin ". . . arises by a long and dense aponeurosis from the outer side of the rostrum on the line of the premaxillo-maxillary suture, its upper border being immediately in front of the infraorbital foramen." This portion passes obliquely downward and backward and inserts upon the inferior crest of the masseteric fossa and the

inferior surface of the mandible from the digastric crest posteriorly to the base of the angular process.

(2) The maxillary part ". . . arises from the side of the anterior part of the maxilla and adjacent parts of the maxillary root of the zygoma. Anteriorly it slightly overlaps the posterior part of the premaxilla immediately below the top of the rostrum, where it forms a distinct crest continuous with the anterior edge of the maxillary root of the zygoma. The principal origin covers the whole of the anterior face of the vertically expanded zygomatic process of the maxilla, and in addition a supplementary sheet takes origin from the posterior face of the same bony plate. Posteriorly its origin is limited on the outer side by a thick aponeurosis, which is firmly attached to the inferior surface of the antero-external angle of the zygoma." This part of the muscle inserts ". . . on the outer side of the neck of the condylar ramus just above the incisor capsule."

(3) The zygomatic part has its origin on the outer surface of the zygoma, outer side of the jugal and from the aponeurotic septum. It inserts upon the angular process of the mandible. The width of the muscle is twice that of the corresponding muscle in the rat and almost two and one-half times the thickness.

M. sternomastoideus (stm., figs. 7, 8, 18). This muscle arises from the anterior border of the manubrium, and inserts onto the mastoid process of squamosal. It is rectangular in shape in the gopher, but is round and long in the rat. Hill (1937) stated that in *Geomys* the ". . . petromastoid element in mastoid process is larger; some fibers attach to it also; sternomastoid more flattened in this genus than in *Thomomys*."

M. cleidomastoideus (clm., figs. 7, 8, 18). This long flat muscle is divided into two parts, both of which arise from the dorsal surface of the medial two-thirds of the clavicle. These two parts insert on the mastoid process dorsal to the sternomastoideus attachment.

M. digastricus (di., figs. 1, 3, 7, 16, 18). This muscle arises from the paroccipital process of the skull and the adjacent parts of the mastoid and the audital bullae, and is inserted on the digastric crest which is posterior to the symphysis menti. The two bellies of the muscle are separated by a tendon of insertion which attaches the two muscles to the hyoid bone. Hill (1937, p. 105) stated: ". . . posterior belly separated from anterior belly by a slight constriction and some tendinous fibers, but no true tendon."

M. sternohyoideus (sth., figs. 7, 8). This muscle arises from the manubrium and inserts on the ventroposterior border of the hyoid bone superficial to the sternothyreoideus.

M. sternothyreoideus (sty., fig. 8). The origin of this muscle is from the dorsal surface of the manubrium and from the anterior borders of the first and second costal cartilages. It inserts onto and depresses the thyroid cartilage. The thickness and width of this muscle in the gopher are twice that of the same in the rat.

M. omohyoideus (omo., figs. 4, 7, 9, 13). The origin of this muscle is from the lateral part of the body of the hyoid bone. It passes posteriorly and laterally and is inserted on the dorsal edge of the superior border of the scapula. At its insertion this muscle passes between the supraspinatus and the subscapularis.

M. splenius capitis (spl., figs. 3, 18). This muscle arises from the supraspinatus ligament as far as the first thoracic vertebra. The fibers insert onto the interparietal bone and along the lambdoidal ridge as far as the fossa between the mastoid process of the squamosal bone and the process of the mastoid bulla. According to Hill (1937), in gophers the muscle "arises from nuchal ligament for most of its length: inserts on superior nuchal line for almost its entire length."

M. biventer cervicis (bi.cs., figs. 11, 18). This muscle arises from the lateral proc-

esses of the third to tenth thoracic vertebrae and inserts by a tendinous band onto the dorsal part of the occipital crest and nuchal line.

M. complexus (cm., figs. 11, 18). This muscle arises from the last three cervical and first two thoracic vertebrae and inserts by a tendinous sheath onto the outer one-half of the nuchal line lateral to the biventer cervicis. It is shorter but much wider and thicker in the gopher than the corresponding muscle in the rat.

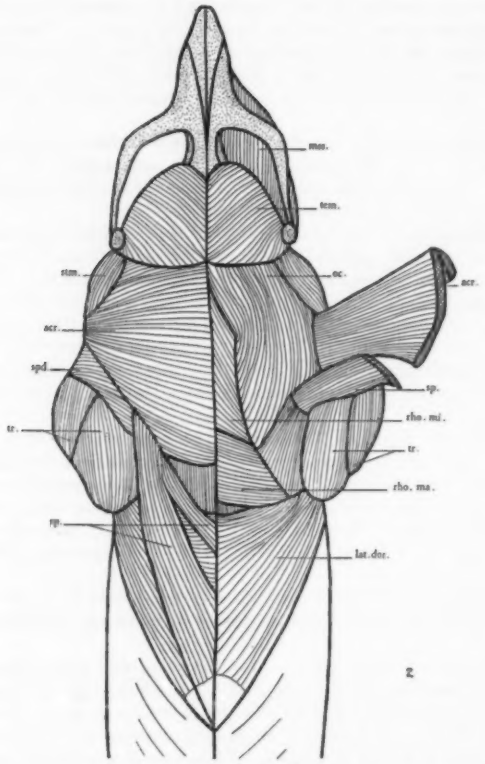


FIG. 2. Dorsal view of the gopher showing superficial muscles

M. rectus capitis posterior major (r.ma., figs. 11, 18). Origin is from the lateral surface of the spine of the axis. It inserts upon the supraoccipital bone from the rectus fossa laterally.

M. rectus capitis posterior minor (r.mi., fig. 18). Origin is from the medial portion of the atlas and it inserts on the supraoccipital bone from the medial ridge to the rectus fossa. The width and thickness show a marked development in the gopher.

M. obliquus capitis superior (o.sup., figs. 11, 18). Origin is from the ventral border of the transverse process of the atlas, and insertion is on the exoccipital bone medial

to the mastoid process and the occipital crest. It is developed to almost twice the proportions of the corresponding muscle in the rat.

M. rectus capitis anterior (r.an., figs. 10, 14). Origin is from the ventromedial portion of the atlas, and insertion on the basioccipital just caudal to the longus capitis.

M. rectus capitis lateralis (r.la., figs. 11, 18). Origin is from the cranial part of the transverse process of the atlas. It inserts upon the slight extension of the angle of the occipital bone running ventral from the process at the inferiolateral end. The width of the muscle is almost three times that of the corresponding muscle in the rat.

M. longus capitis (lo.cap., figs. 9, 10, 14). Origin is from the last four transverse processes of the cervical vertebrae; insertion is on the anterior part of the basioccipital bone.

M. spinotrapezius (sp., figs. 1, 2, 12). In the pocket gopher this muscle is divided into two portions, anterior and posterior. The former arises from the spinous processes of the fifth and sixth thoracic vertebrae and inserts on the proximal part of the spine of the scapula. The posterior portion arises from the spines of the twelfth thoracic and first lumbar vertebrae and from the fascia that is attached to the second and third lumbar vertebrae. The insertion of this portion is on the proximal half of the spine of the scapula. The muscle is triangular in the rat, but in the gopher each portion is ribbon-shaped. Hill (1937) stated that in *Thomomys* the smaller portion arises from the sixth and seventh thoracic, and the larger portion has a slightly larger space of origin.

M. clavotrapezius (cvt., figs. 3, 7, 18). This muscle is a thin, strong band which arises from the superior nuchal line and the external occipital protuberance. It passes ventrally and laterally and inserts on the posterior border of the outer one-third of the clavicle. It does not differ greatly in the gopher and the rat, being slightly wider and longer, but of the same thickness. Hill (1937) gave the name cleidomastoideus to this muscle.

M. acromiotrapezius (acr., figs. 1, 2, 12, 18). In the pocket gopher the acromiotrapezius is about twice as thick as in the rat. It arises from the supraspinous ligament of all the cervical and the first two thoracic vertebrae, and has a part of its origin from the lambdoidal ridge and the external occipital protuberance. In the gopher it covers a great deal of the neck region; it overlaps the levator claviculae, whereas in the rat the levator scapulae overlaps the insertion of the acromiotrapezius at the acromion process. In *Thomomys*, according to Hill (1937), the origin extends to the fourth thoracic vertebra.

M. latissimus dorsi (lat. dor., figs. 1, 2, 4, 13). This muscle arises from the supraspinous ligament from the spines of the sixth to twelfth thoracic vertebrae, and from the dorsolumbar fascia as far as the level of the third lumbar vertebra. These fibers converge laterally and insert on the upper third of the medial surface of the shaft of the humerus just below the lesser tuberosity under cover of the biceps brachii. It joins with the teres major in a common insertion.

M. occipitoscapularis (or rhomboideus capitis) (oc., figs. 2, 12). This trapezoidal-shaped muscle arises from the lambdoidal ridge, directly beneath the acromiotrapezius, and inserts on the caudal three-fourths of the spine of the scapula and onto the cephalic one-third of the vertebral border of the scapula. It has marked development in width and thickness.

M. rhomboideus minor (rho.mi., figs. 2, 3, 12). The rhomboideus major and minor are closely united and appear as one muscle in the pocket gopher, but they are more clearly differentiated in the rat. The minor part originates from the supraspinous ligament of all the cervical and the first two thoracic vertebrae. It inserts in the cephalic two-thirds of the vertebral border of the scapula.

M. rhomboideus major (rho.ma., figs. 2, 3, 12). The major has its origin from the spinous process and supraspinous ligament of thoracic vertebrae three, four and five. It inserts on the posterior or caudal one-third of the vertebral border of the scapula. The major slightly overlaps the minor. This muscle is thick and quadrilateral in shape. Hill (1937) stated that it is single in the pocket gophers, arising from middorsal line, dorsal to last six cervical vertebrae and first four thoracics.

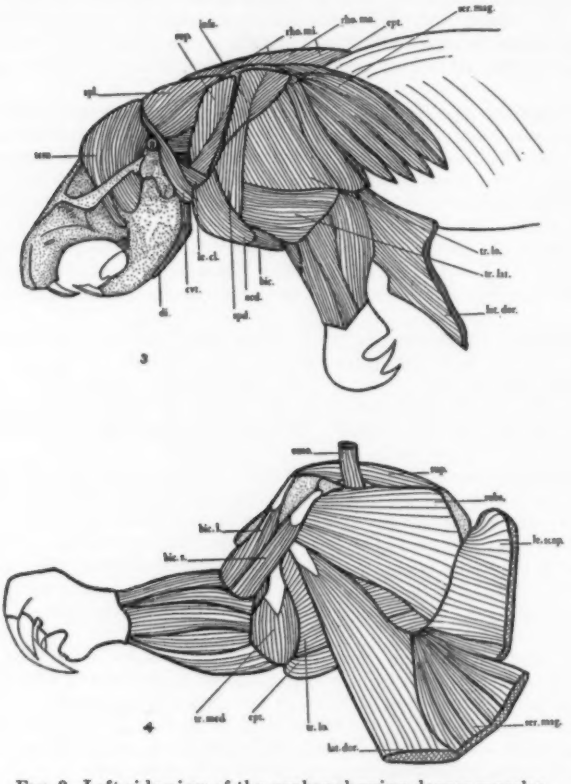


FIG. 3. Left side view of the gopher showing deeper muscles
FIG. 4. Medial view of right front limb of the gopher

M. levator scapulae (le.scap., figs. 4, 13). Origin is from the transverse processes of the last four cervical vertebrae, and by slips from the first two ribs. It inserts onto the vertebral border of the scapula, anterior to the serratus magnus, with which it is practically continuous. This muscle has a marked development in thickness and width, the latter being greater than the length.

M. levator claviculae (le.cl., figs. 7, 9, 12, 13, 14). Origin is from the anteroventral border of the transverse process of the atlas and from the ventral surface of the basioccipital bone, caudal to the attachment of the rectus capitis anterior. It inserts on the

outer one-third of the anterior margin of the clavicle and on the metacromion process, being overlapped by the clavotrapezius. The width of this muscle is two and one-half times as great as the corresponding muscle in the rat. Hill (1937) gave the name omocervicalis to this muscle.

M. serratus magnus (ser.mag., figs. 3, 4, 13). The muscle arises by slips from the third to the eighth rib, and inserts on the caudal portion of the medial side of the vertebral border of the scapula, some of the fibers uniting with the tendinous fibers which connect with the dorsoepitrochlearis muscle.

M. subclavius (sbc., fig. 8). This small muscle arises from the junction of the first rib with its costal cartilage, and is inserted on the dorsal and caudal surfaces of the lateral one-half of the clavicle.

M. pectoralis major (pec.ma., fig. 13). This muscle is divided into two portions. The first part arises from the manubrium and from the medial one-half of the clavicle. This part of the muscle inserts by a tendinous band on the medial edge of the distal part of the deltoid tuberosity of the humerus. The second part arises from the lateral part of the sternum from the manubrium to the xiphoid cartilage. It inserts by a tendinous band on the medial edge of the deltoid tuberosity of the humerus.

M. pectoralis minor (pec.mi., fig. 13). The minor is also divided into two portions. The first part arises by fibers from sternebrae two to five and by a tendinous sheet from the same costal cartilages. It is covered entirely by the major part of the muscle. It inserts on the medial surface of the coracoid process of the scapula. The second portion of the muscle arises from the xiphoid cartilage of the sternum and the abdominal fascia. It passes forward and outward and inserts by a tendinous band on the medial edge of the deltoid ridge.

M. teres major (ter.ma., figs. 6, 12, 13). This muscle arises from the infraglenoid fossa of the scapula and inserts into the medial ridge of the shaft of the humerus just below the lesser tuberosity, and beneath the latissimus dorsi.

M. teres minor (ter.mi., figs. 12, 13). Origin is from the ventral third of the glenoid border of the scapula, and insertion is onto the greater tuberosity of the humerus just distal to the infraspinatus.

M. subscapularis (subs., figs. 4, 13). This muscle arises from the whole surface of the subscapular fossa and from the proximal two-thirds of the lateral edge of the glenoid border. It inserts by a tendon onto the dorsal border of the lesser tuberosity of the humerus. The muscle is twice as wide and almost three times as thick as in the rat.

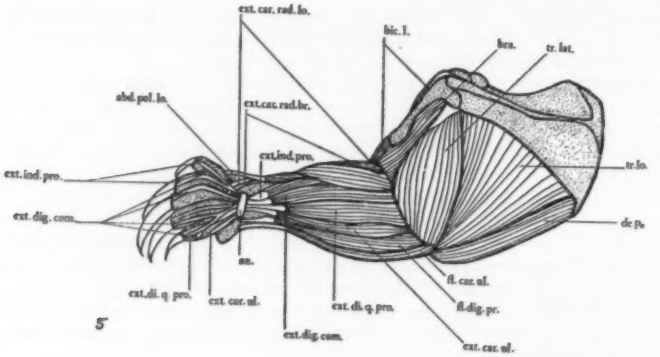
M. infraspinatus (infs., figs. 3, 12). This muscle occupies the entire infraspinous fossa of the scapula. It arises from the ventral surface of the spine of the scapula, from the vertebral border below the spine, and from the distal and dorsal third of the glenoid border. It inserts on the lateral surface of the greater tuberosity of the humerus. This muscle is powerfully developed in both thickness and width as compared to the rat.

M. supraspinatus (sup., figs. 3, 12, 13). This is a thick muscle occupying the whole supraspinous fossa of the scapula. It arises from the anterior margin of the scapula, from its vertebral border as far as the spine, from the superior surface of the spine, and from the whole supraspinous fossa. It inserts into the anterior margin of the greater tuberosity of the humerus.

M. acromiodeltoideus (acd., figs. 1, 3, 7, 12). This muscle covers the shoulder. It arises from the lateral one-half of the ventral surface of the clavicle, and from the acromion process. It inserts into the deltoid tuberosity of the humerus. The muscle is almost double the size of the corresponding muscle in the rat. Hill (1937) gave the name deltoideus to this muscle. The origin is more extensive in *Thomomys*, arising from lateral three-quarters of clavicle, from acromion, from spine of scapula, and fascia of the infraspinatus.

M. spinodeltoideus (spd., figs. 1, 3, 12). This muscle is rather flat and triangular.

It arises from the infraspinous fascia and the anterior one-half of the spine of the scapula. It inserts into the dorsolateral part of the tuberosity of the deltoid ridge of the humerus. It is overlapped by the acromiodeltoideus. This muscle is quite long and slender and is not much wider than, and not quite as thick as, the same muscle in the rat. Hill (1937) found in *Thomomys* that the deltoideus was not distinctly divided into two parts, but in *Geomys* there are two distinct muscles, acromiodeltoideus and spinodeltoideus.



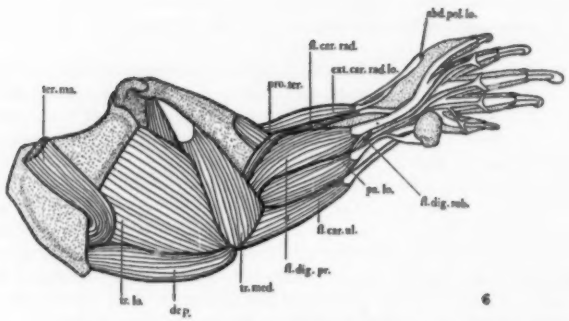


FIG. 5. Lateral view of left front limb of the gopher
FIG. 6. Medial view of left front limb of the gopher

M. triceps brachii (tr., figs. 5, 6, 12, 13). This muscle is very large and furnishes, with the dorsoepitrochlearis, nearly all the power for the backward stroke of the forearm in digging. It is divided into three portions: caput longum, caput laterale, and caput mediale. The long head arises from the proximal three-fourths of the lateral edge of the glenoid border of the scapula. It inserts into the end of the olecranon process of the ulna. The medial head arises from the posterior and medial surfaces of

the humerus just below the lesser tuberosity and extending almost to the distal end of the bone. It inserts on the olecranon. The lateral head arises by a tendinous band from the posterior and lateral surfaces of the humerus, just below the head of the humerus and down to the deltoid tuberosity. This part of the muscle also inserts into the olecranon. According to Hill (1937) the long head of the triceps of *Thomomys* is

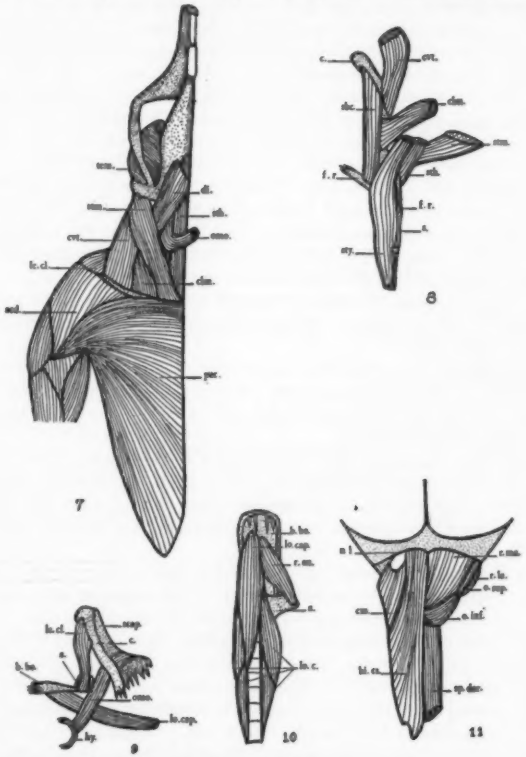


FIG. 7. Ventral view of right side of the gopher.
FIG. 8. Sagittal view through the sternum of the gopher.
FIG. 9. Drawing of dissection to show special muscles of the gopher.
FIG. 10. Ventral view of prevertebral muscles attached to the head of the gopher.
FIG. 11. Dorsal view of deep postvertebral muscles attached to the head of the gopher.

divided into two parts, and these two parts are smaller than the single long head in *Geomys*.

M. anconaeus (anc., fig. 13). This short muscle arises from the ridge of the medial epicondyle of the humerus and inserts on the medial surface of the olecranon. It is greatly developed in comparison with that of the rat, with a length, width, and thick-

ness more than twice as great. Holliger (1916) stated that it is quite weak in the California species *Thomomys bottae*. He further said that there is an anconaeus lateralis which is very small, although he found no evidence of a like muscle in the rabbit, and Greene (1935) did not find any such muscle in the white rat. No anconaeus lateralis was noted in the *Geomys bursarius*.

M. dorsoepitrochlearis (dep., figs. 5, 6, 12, 13). This muscle arises from the glenoid border of the scapula at the distal one-fourth of both the medial and lateral edges. It also derives some fibers from the fascia of the teres major and forms a common tendon which joins with the serratus magnus. From this complex origin it inserts medially on the tip of the olecranon process. The muscle is closely related to the triceps and could be called a part of it. It has the same action as the triceps, that of extending the forearm. This muscle is very weak in the rat as compared with the pocket gopher, where it is twice as long, twice as wide, and over six times as thick.

M. biceps brachii (bic., figs. 4, 13). The caput breve of the biceps brachii and the coracobrachialis arise by a common tendon from the coracoid process of the scapula. A short way down the two muscles separate and become distinct muscles. The short head inserts by a common tendon with the brachialis on the medial side of the ulna, and a few fibers insert also on the ulna surface of the radius.

Caput longum arises from the anterior edge of the glenoid cavity, its tendon passing through the intertubercular sulcus. With the short head and brachialis it has the same insertion as for caput breve.

M. coracobrachialis (cor., fig. 13). Coracobrachialis arises by a common tendon from the coracoid process of the scapula. It derives some of its fibers from the extensor surface of caput breve biceps brachii. This muscle inserts on the distal half of the medial surface of the humerus.

M. brachialis (bra., figs. 5, 12, 13). This muscle originates from the greater tuberosity and from the neck of the humerus. It curves about the shaft of the humerus and inserts, with the biceps brachii, by a common tendinous band into the medial surface of the ulna, and a few fibers insert onto the ulnaris side of the radius. Hill (1937) noted two imperfectly separated heads.

M. extensor carpi radialis brevis (ext.car.rad.br., figs. 5, 12). Origin is from the lateral epicondylar ridge of the humerus, ventral to the extensor carpi radialis longus, and insertion is midway on the dorsal surface of the third metacarpal.

M. extensor carpi radialis longus (ext.car.rad.lo., figs. 5, 12). This muscle arises from the lateral epicondylar ridge of the humerus and inserts on the radial side of the second metacarpal near its base. The tendon, along with that of the extensor carpi radialis brevis, passes beneath the tendon of the abductor pollicis longus.

M. extensor carpi ulnaris (ext.car.ul., figs. 5, 12). Origin is by two slips, one from the lateral epicondyle of the humerus, and the other from the lateral surface of the ulna in a curved line posterior to the origin of the abductor pollicis. It inserts on the base of the lateral surface of metacarpal five. The muscle is over twice as thick as the corresponding muscle in the rat, and is very powerful.

M. extensor digitorum communis (ext.dig.com., figs. 5, 12). This muscle arises from the lateral epicondyle of the humerus ventral to the extensor carpi radialis brevis. After passing beneath the annular ligament, the tendon divides into four parts, which insert at the bases of the terminal phalanges two to five.

M. extensor digiti quinti proprius (ext.di.q.pro., figs. 5, 12). Origin is from the lateral epicondyle of the humerus, lateral to the extensor digitorum communis. It passes beneath the annular ligament, and becomes superficial in the metacarpal region. There it divides into two parts, one of which inserts on the distal end of the dorsal surface of metacarpal five, and the other on the base of the terminal phalanx of digit five.

M. supinator (su., fig. 12). Origin is from the lateral epicondyle of the humerus, and insertion is on the proximal third of the cephalic surface of the radius.

M. abductor pollicis longus (abd.pol.lo., figs. 5, 12). Origin is quite extensive, partly from the lateral surface of the ulna from the articulation of the ulna and humerus to the middle of the bone, and from the interosseous membrane. It occupies the deeply grooved lateral surface of the ulna. About one-third of the way from the wrist to the elbow the muscle becomes superficial. After passing under the collateral ligament the tendon of the muscle passes over the tendons of the extensores carpi radialis, and inserts on the radial side at the base of metacarpal one.

M. extensor pollicis longus. While this muscle is very distinct in the rat, it is not so clearly recognizable in the pocket gopher, but in that animal it has partly fused with

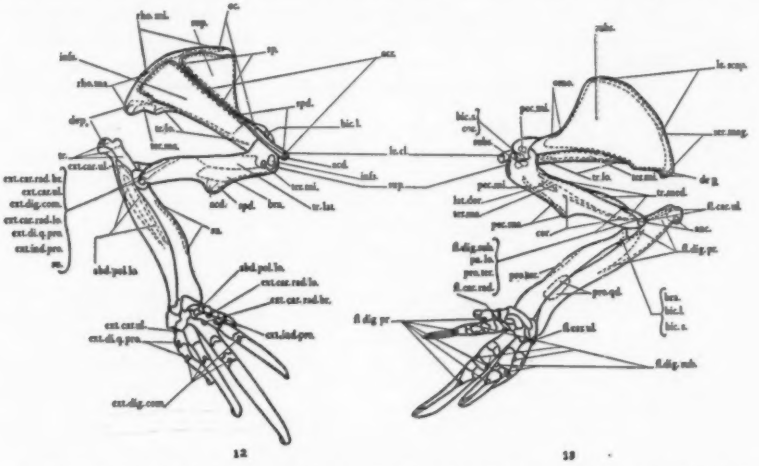


FIG. 12. Lateral view of right front appendage showing areas of muscle origins and insertions.

FIG. 13. Medial view of right front appendage showing areas of muscle origins and insertions.

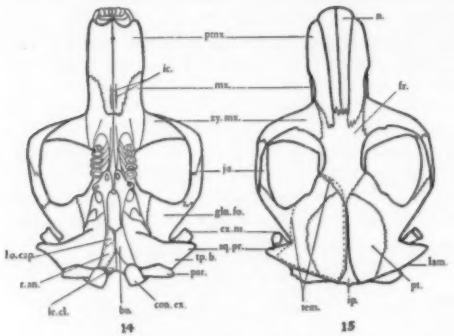
the extensor indicis proprius, only a tendon slip extending to the distal phalanx of the pollex. Holliger (1916), in his work on *Thomomys bottae*, did not find this particular muscle.

M. extensor indicis proprius (ext.ind.pro., figs. 5, 12). Origin is from the lateral epicondyle of the humerus. The tendon passes beneath the annular ligament. In the metacarpal region it divides into two parts, the medial of which represents the extensor pollicus longus, to the distal phalanx of the pollex, while the lateral part inserts as usual on the distal end of the dorsal surface of metacarpal two. This muscle is very much wider than the corresponding muscle in the rat.

M. palmaris longus (pa.lo., figs. 6, 13). The origin of this muscle is from the medial epicondyle of the humerus in common with the flexor group of muscles. It is superficial throughout its entire length. It inserts into the palmar fascia near the pisiform bone, and extends onto the palmar surface of the manus. Hill (1937) stated that in *Thomomys* this muscle inserts on the falciform bone and fascia of hand.

M. pronator teres (pro.ter., fig. 13). This muscle arises from the medial epicondyle of the humerus and inserts on the anteromedial surface of the radius. According to Hill (1937) the muscle is smaller in *Thomomys*.

M. flexor carpi radialis (fl.car.rad., figs. 6, 13). This muscle arises with the common flexor tendon from the medial epicondyle, and inserts on the palmar surface of metacarpal two. Hill (1937) stated that this muscle inserts on radial sides of metacarpals two and three.



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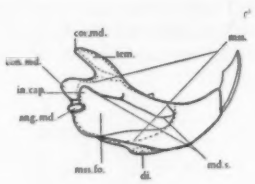

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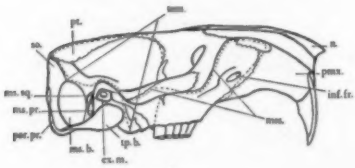

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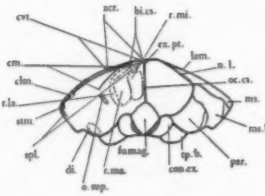

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FIG. 14. Ventral view of the skull of the gopher showing area of muscle origins and insertions.

FIG. 15. Dorsal view of the skull of the gopher showing areas of muscle origins and insertions.

FIG. 16. Lateral view of the mandible of the gopher showing areas of muscle origins and insertions.

FIG. 17. Lateral view ot the skull of the gopher showing areas of muscle origins and insertions.

FIG. 18. Posterior view of the skull of the gopher showing areas of muscle origins and insertions.

M. flexor carpi ulnaris (fl.car.ul., figs. 5, 6, 13). This muscle arises from the medioventral surface of the olecranon of the ulna and the medial epicondyle of the humerus. It inserts at the tip of the pisiform bone.

M. flexor digitorum sublimis (fl.dig.sub., figs. 6, 13). Origin of this muscle is from the medial epicondyle of the humerus in association with the ulnar head of the flexor digitorum profundus. Its tendon passes superficial to the tendon of the flexor digitorum profundus. Halfway down the forearm the muscle splits into three portions. Upon reaching the palmar region a fourth slip is given off from the lateral tendon.

These four tendons pass to metacarpals two to five, and then each divides into two portions, one on either side of the proximal phalanges. They then pass around the tendons of the flexor digitorum profundus and are inserted near the distal end of the middle phalanges.

M. flexor digitorum profundus (fl.dig.pr., figs. 6, 13). This muscle has quite an extensive origin, and three parts are recognized: (1) from the medial surface of the ulna from the olecranon to the middle of the bone; (2) from the common flexor tendon of the medial epicondyle of the humerus; and (3) from the ventromedial border of the ulna. These three parts unite to form a common tendon which passes between the pisiform bone and the other carpals. When it reaches the palm of the manus, the tendon divides into five parts which are inserted into the palmar surfaces of the terminal phalanges of all five digits. The width of the muscle in the gopher is double that of the corresponding muscle in the rat. Hill (1937) recognized four divisions.

M. pronator quadratus (pro.qd., fig. 13). This muscle is deep and under cover of the flexor muscles. Its origin is from the flexor surface of the distal third of the ulna, and it inserts on the medial surface of the distal one-third of the radius.

Discussion and Conclusions

The musculature of the anterior portion of the pocket gopher's body has been modified in order to meet the requirements of a fossorial habitat. The most noticeable feature of the bone surfaces is the irregularity of outline. The processes of attachment are large, thus giving a greater area of attachment for the muscles.

Most of the muscles present a marked development in thickness, less so in width, and hardly any of them have developed greatly in length as compared with the corresponding muscles of the unspecialized rat. The muscles of the neck region, superficial or deep, show a marked degree of thickening and of widening.

The gopher uses its jaws in loosening and cutting soil. The main muscles (digastricus, masseter and temporalis) that control jaw movements are markedly developed in all three proportions, especially in thickness

The muscles of the forearm, as well as those of the arm, are developed in width and thickness. The flexors and extensors of the forearm have powerful and direct movements which are essential in digging. Two muscles that have undergone the greatest adaptation and modification are the dorsoepitrochlearis and triceps brachii. These two muscles furnish nearly all the power needed to pull the front limb caudally. During this backward stroke, the gopher has his claws imbedded in the soil, and a powerful pull is needed to loosen the dirt.

The long head of the triceps brachii has undergone the greatest modification. It is triangular in shape and arises from the proximal three-fourths of the lateral edge of the glenoid border of the scapula. The other two portions of the muscle are developed to a much greater extent than the corresponding portions of the triceps brachii of the rat. This muscle's greatest development is in thickness and width, but it is also slightly greater in length.

[Studies from the Zoological Laboratory of the University of Nebraska, No. 204.]

List of Abbreviations

abd. pol. lo.	M. abductor pollicis longus
acd.	M. acromiodeltoideus
acr.	M. acromiotrapezius
anc.	M. anconaeus
bi. cs.	M. biventer cervicis
bic.	M. biceps brachii

bic. l.	M. biceps brachii (long head)
bic. s.	M. biceps brachii (short head)
bra.	M. brachialis
clm.	M. cleidomastoideus
cm.	M. complexus
cor.	M. coracobrachialis
cvt.	M. clavotrapezius
dep.	M. dorsoepitrochlearis
di.	M. digastricus
ext. car. rad. br.	M. extensor carpi radialis brevis
ext. car. rad. lo.	M. extensor carpi radialis longus
ext. car. ul.	M. extensor carpi ulnaris
ext. dig. com.	M. extensor digitorum communis
ext. di. q. pro.	M. extensor digiti quinti proprius
ext. ind. pro.	M. extensor indicis proprius
fl. car. rad.	M. flexor carpi radialis
fl. car. ul.	M. flexor carpi ulnaris
fl. dig. pr.	M. flexor digitorum profundus
fl. dig. sub.	M. flexor digitorum sublimis
infs.	M. infraspinatus
lat. dor.	M. latissimus dorsi
le. cl.	M. levator claviculae
le. scap.	M. levator scapulae
lo. c.	M. longus colli
lo. cap.	M. longus capitis
mss.	M. masseter
oc.	M. occipitoscapularis
o. inf.	M. obliquus capitis inferior
o. sup.	M. obliquus capitis superior
omo.	M. omohyoideus
pa. lo.	M. palmaris longus
pec.	M. pectoralis
pec. ma.	M. pectoralis major
pec. mi.	M. pectoralis minor
pro. qd.	M. pronator quadratus
pro. ter.	M. pronator teres
r. an.	M. rectus capitis anterior (minor)
r. la.	M. rectus capitis lateralis
r. ma.	M. rectus capitis posterior major
r. mi.	M. rectus capitis posterior minor
rho. ma.	M. rhomboideus major
rho. mi.	M. rhomboideus minor
sbc.	M. subclavius
sp. dor.	M. spinalis dorsi
spd.	M. spinodeltoideus
ser. mag.	M. serratus magnus
sp.	M. spinotrapezius
spl.	M. splenius capitis
sth.	M. sternohyoideus
stm.	M. sternomastoideus
sty.	M. sternothyreoideus
su.	M. supinator

subs.....M. subscapularis
sup.....M. supraspinatus
tem.....M. temporalis
ter. ma.....M. teres major
ter. mi.....M. teres minor
tr.....M. triceps brachii
tr. lat.....M. triceps brachii (lateral head)
tr. lo.....M. triceps brachii (long head)
tr. med.....M. triceps brachii (medial head)
a.....atlas
acr. proc.....acromion process
an.....annular ligament
ang. md.....angle of mandible
b. bo.....basal plate of basioccipital
bo.....basioccipital
c.....clavicle
con. ex.....condyle of exoccipital
con. md.....condyle of mandible
cor. md.....coronoid process of mandible
ex. m.....external auditory meatus
ex. pt.....external occipital protuberance
fo. mag.....foramen magnum
f. r.....first rib
fr.....frontal
gln. fo.....glenoid fossa
h.....humerus
ic.....incisive foramen
in. cap.....incisor capsule
inf. fr.....infraorbital foramen
ip.....interparietal
ju.....jugal
lam.....lambdoidal ridge
md. s.....mandibular shelf
ms.....mastoid process
ms. b.....mastoid bulla
ms. pr.....mastoid process of mastoid bulla
ms. sq.....mastoid process of squamosal
mss. fo.....masseteric fossa
mx.....maxilla
n.....nasal
n. l.....nuchal line
oc. cs.....occipital crest
par.....paroccipital
par. pr.....paroccipital process of exoccipital
pmx.....premaxilla
pt.....parietal
s.....sternum
scap.....scapula
so.....supraoccipital
sq. pr.....squamosal process of squamosal
tp. b.....tympanic or audital bulla
zy. mx.....zygomatic process of maxilla

LITERATURE CITED

EYCLESHYMER, A. CHAUNCEY 1917. Anatomical Names. William Wood & Co., New York.

GREENE, EUNICE CHACE 1935. Anatomy of the Rat. Trans. Amer. Philos. Soc., Philadelphia.

HILL, JOHN ERIC 1937. Morphology of the pocket gopher, mammalian genus Thomomys. Univ. California Publ. Zool., vol. 42, pp. 81–172.

HOLLINGER, CHARLES DANIEL 1916. Anatomical adaptations in the thoracic limb of the California pocket gopher and other rodents. Univ. California Publ. Zool., vol. 13, pp. 447–495.

HOWELL, A. BRAZIER 1926. Anatomy of the Wood Rat. William & Wilkins Co., Baltimore.

MERRIAM, C. HART 1895. Monographic revision of pocket gophers, family Geomyidae. North Amer. Fauna, no. 8, pp. 1–258.

Underwood High School, Omaha, Nebraska.

THE BACULUM OF SOME SCIURIDAE AND ITS SIGNIFICANCE IN DETERMINING RELATIONSHIPS

BY OTIS WADE AND PAUL T. GILBERT

The present paper deals with an obscure and little-studied structure, the *baculum* or os penis, of some of the representative North American Sciuridae. It is a structure present in most rodents, showing considerable variation among the genera, and even species, yet its development has followed lines seemingly well defined, resulting in the formation of recognizable types that are distinctive of certain groups and, what is most significant, that furnish some evidence of degrees of relationship and specialization.

Burt (1937) has shown that the baculum is an important character in determining relationships among the pocket-mice and the kangaroo-rats. Justifying the use of this structure in his studies he says (page 146),—"The baculum is situated internally where it is not subjected to the same modifying influences of stresses and strains as are the bones of the limbs and skull. Its true character, therefore, is less likely to be disguised by extraneous factors. If this be true the characters of the baculum should indicate to a greater extent the real affinities of the animal." More recently A. H. Howell (1938) has used the baculum as a character in his revision of the ground squirrels and in a classification of the Sciuridae. He recognized that it has characters of assistance in defining the groups without, however, considering it of more than secondary importance in establishing generic relationships.

American mammalogists generally, have been slow to recognize this structure as a valuable aid in determining group relations. Several European zoologists, however, have seized upon it as a trenchant character in the classification of the Sciuridae. Oldfield Thomas (1915), who appears to be the first to have given this element serious consideration in his effort to deter-

mine group affinities, coined the term *baculum* when he wrote "since every other bone of the skeleton has a name of its own, not merely the 'bone of the leg' or 'bone of the head,' it appears to me convenient to have a special term for the bone of the penis and I therefore propose to call it the *baculum*, meaning a little stick." Pocock (1923) used it in constructing an interesting classification of the Sciuridae.

The material used in this study is a part of a general collection of rodent bacula which we have been getting together for several years. Several friends have collected specimens for us. Our especial appreciation is due to Professor W. J. Hamilton, Jr., of Cornell University, for bacula of the eastern chipmunk and the eastern gray squirrel of New York, and to Professor George E. Hudson of Washington State College, for bacula of the flying squirrel, the gray squirrel and the fox squirrel, all of South Carolina. The junior author has made all the drawings and measurements.

In dissecting bacula for study at first, we learned that we were often ruining the specimen by removing too much or breaking off parts, still soft or cartilaginous, but properly a part of the element. This is demonstrated by the bacula of some tree squirrels (fig. 3, A to D), where a component part ossifies late and only in part. This comes away easily in young individuals and is therefore nearly always lost; only in fully adult males is it bony and firmly ankylosed to the distal end of the baculum. The bacula also of young individuals of various species often are not typical. Among them there is great variation, and characteristic features may be undeveloped, or impossible of saving in dissection. We believe this fact accounts, in part, for certain discrepancies to be noted between our descriptions and figures and those of Pocock (1923) and Howell (1938). Burt (1937) noted the differences in the bacula of young individuals of the forms he worked with. He wrote: "There is considerable age variation, however, for the baculum seems not to be fully developed until the animal is adult."

We have not found significant differences in the bacula of any of the subspecies; and in one notable case among the tree squirrels, this element, except for size, was so similar in all the representatives we studied (*Sciurus c. carolinensis*, *S. c. leucotis*, *S. niger niger* and *S. n. rufiventer*) of two subgenera of tree squirrels (*Neosciurus* and *Parasciurus*) that no structural distinctions could be made.

In this paper we have adhered to the classification constructed by Howell (1938).

Measurements of the bacula given in the text, unless otherwise indicated, are of the largest specimen we had of each species.

THE GROUND SQUIRRELS

The ground squirrels (*Citellus*) present a greatly modified and specialized baculum. It, with that of the prairie dogs, forms a very distinctive type characterized principally by the greatly expanded distal end into a spoon-

like disc, the serrate or irregular margins of this disc, and the conspicuous termination of the shaft beneath it as a bump or projection. This type is relatively quite short, with the shaft tending to curve upward at or near the tip. The termination of the shaft beneath the disc varies among the species in bluntness and prominence. The margins of the disc are irregular in outline and may be strongly serrate or denticulate. The bone is not quite symmetrical in the species we have examined. Group differences are also apparent.

Material from the following species has been available for study.

Citellus lateralis (Say). Male specimens of *C. lateralis* (fig. 1, A & B) from Colorado have been examined. All had well-developed bacula. The distinctive features are (a) in the shaft which has an acute bend just beyond the middle bringing the distal end upward, (b) in the disc itself where concavity narrows acutely backward into the neck, and where sides slope inward to form a more narrowed trough-like bottom, and (c) in size, it being the smallest baculum among all the species of *Citellus* studied. Anteriorly the rim of the disc on each side is armed with several tooth-like projections while posteriorly it is smooth. The right side of the trough-like disc is usually somewhat wider; this feature, together with the slightly twisted shaft, prevents the bone from being quite symmetrical. The end of the shaft extends quite prominently forward in pointed fashion beyond the disc. Length 2.7 mm.

Citellus variegatus grammurus (Say). The baculum (fig. 1, C & D; fig. 2, M) of the rock squirrel of Colorado conforms well to the ground squirrel type but lacks the extreme widening of the disc, which exhibits two prominent tooth-like anterior projections, strongly recurved, almost hooked, at their tips. The bluntly irregular end of the shaft extends forward conspicuously underneath these projections. The shaft is usually fairly straight although we have seen this element in younger individuals with the right side of the shaft strongly bent inward. There is a tendency, seemingly, for the expanded tip to incline somewhat to the left; it is broadly oval, although some are more triangular in shape with the margins less strongly toothed. Here again is a condition due to immatureness, we believe, and to illustrate this we have added a drawing (fig. 2, M) of the element from a young individual showing such a terminal expansion and, also, a slightly curved shaft. Bacula taken from half-grown *grammurus* show the shafts very strongly curved and the tip only slightly expanded and very imperfect. Length 4.4 mm.

Citellus tridecemlineatus (Mitchill). This structure in the 13-striped ground squirrel (fig. 1, E, F & G) stands out in having the edge of the widely expanded disc more prominently and uniformly toothed than any other species thus far examined. It is also the longest of any *Citellus* examined. The shaft is almost straight although twisted; in some cases this is very pronounced, and the tip is only slightly upturned. In all specimens we have seen the expanded tip has a shallow depression on top. This ground squirrel, very common in Nebraska, has afforded us an abundance of material for examination. Pocock's description and figures (1923) of the baculum are so at variance with this material that it seems certain that he must have had specimens from other than the one in question, or else they were immature or poorly dissected out. First, no specimen we have examined shows the wide notch on the anterior rim of the disc (Howell also mentions a "wide cleft in the center"); second, in no case has there been observed a disc with the edge armed with two rows of teeth. In several specimens we have noticed that the disc does bear on the "wings" posteriorly, just below the main row of teeth, several teeth or prominent downward projections which, when viewed from the side, as

shown in fig. 1, G, give the appearance of a burr-like formation, but this is not a constant feature. Length 5.8 mm.

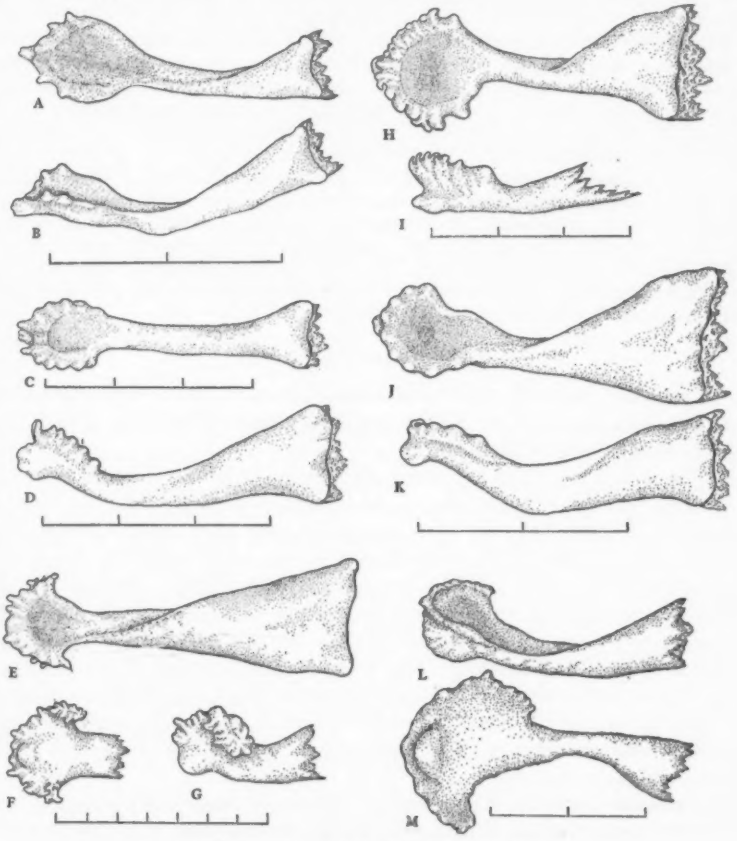


FIG. 1. Views of the bacula of *Citellus*
(In each case the scale is divided into millimeters)

A & B	*C. lateralis*
C & D	*C. variegatus grammurus*
E, F & G	*C. tridecemlineatus*
H & I	*C. franklinii*
J & K	*C. richardsonii elegans*
L & M	*C. spilosoma obsoletus*

Citellus franklinii (Sabine). In this species the shaft of the baculum (fig. 1, H & I) shows a perceptible twist; the edge of the disc is not so strongly toothed, although it

does have uneven projections which are usually short and less pointed; and most strikingly, the tip of the shaft projects free quite prominently beneath and in front of the disc, and varies from flat, pointed to bluntly rounded or uneven; it may be turned slightly downward in some cases. Length 5.2 mm.

Citellus richardsonii elegans (Kennicott). (Fig. 1, J & K.) The baculum of this subspecies is relatively short, with a shaft rather strongly twisted. The disc is widely expanded with a circular depression, and without marked projections, being only slightly irregular. Interestingly, this baculum, in shape and general appearance, bears a resemblance to that of the white-tailed prairie dog, to a degree approached in no other species of *Citellus* we have seen. Length 3.4 mm.

Citellus spilosoma obsoletus (Kennicott). The baculum of *C. s. obsoletus* (fig. 1, L & M) is remarkable in being mostly disc, which is exceedingly wide and long in proportion to the size of the shaft. It is a short baculum, being only slightly longer than that of *C. r. elegans*. It is asymmetrical, since the short shaft shows the twisted effect, and the disc is very unevenly expanded. The right side of the disc has a rather straight, thickened edge, shorter than the left side, which is somewhat thinner, more irregular, and more rounded. Length 3.8 mm.

THE PRAIRIE DOGS

We have had for study specimens of the white-tailed form, *Cynomys leucurus* Merr. (fig. 2, A & B) and of *Cynomys ludovicianus* (Ord), (fig. 2, C & D), the black-tailed prairie dog.

The bacula in these two subgenera show several rather well marked group characters, yet are enough alike to be separated with difficulty unless examined in detail. Likewise when compared with their nearest allies, the ground squirrels, we find great similarity; on the other hand they are quite distinct from the bacula of the marmot we had for study. Relatively this element is appreciably smaller than that of the ground squirrels, although almost as much specialized, but noticeably larger than and not nearly so simple as that of its big relative, the woodchuck. It is like that of *Citellus* in symmetry with a shaft slightly twisted and ending as a prominent projection in front; and in the expansion of the distal end into a prominent cup-like structure with crenulate or denticulate rim. It is unlike the baculum of *Marmota* in these features.

The general view that *Cynomys* and *Citellus* are more closely related to each other than to other Sciuridae, including the marmots, gains much support from the great similarity of their bacula. The evidence, we believe, points to a common origin with a divergence relatively recent, while the *Marmota* and the *Cynomys-Citellus* lines separated from a common stock at an earlier time, the latter undergoing greater modification and specialization.

The baculum of *Cynomys leucurus*, although smaller, is somewhat more modified than that of *C. ludovicianus*. The shaft is deeply bent in and concave on the right side. The distal end is expanded into a broad, rather flat disc, which contains an oval depression. Anteriorly the rim of the disc has projections which are fairly conspicuous. Usually they are more prominent on the right side. The width of the disc is as great, or almost so, as its length (a character so distinctive of the *Citellus* type) and is broadly rounded in

front; the left side tends to be less strongly developed. The end of the shaft is blunt and somewhat irregular and extends forward under the disc in a fashion similar to this modification which is so pronounced in *Citellus*. To see this element alone, without knowing its origin, one would be inclined to place it with the *Citellus* group. Except for size it bears a close resemblance to that of *Citellus richardsonii elegans*. Length 4.2 mm.

Of interest here is Anthony's statement (1928, p. 222) that *Cynomys leucurus* is "more like a Ground Squirrel (*Citellus*) in appearance than the forms of *ludovicianus*."

In the black-tailed species, *C. ludovicianus*, the baculum is as strongly bent in on the right side of the shaft and with a furrow-like concavity almost as pronounced as in *C. leucurus*, but the disc is narrower, giving a more elongate effect. The oval depression in the top of the disc is deeper, being almost well-like. The rim is denticulate and somewhat squarish in front and the lateral margins of the cup may bear several tooth-like projections. Length 4.6 mm.

THE MARMOTS

Specimens of but one species of the mountain marmot or rock chuck have been available for study. This one, *Marmota flaviventris* Audubon & Bachman, has a baculum (fig. 2, E & F) markedly simple, the least specialized of any of the Sciuridae known to us, and relatively the smallest. The transverse diameter is about equal throughout except at the base where it is strongly expanded for a short distance. It is weakly curved upward, and a very little to the left at the tip, with a trace of a furrow-like depression on top. The blunt tip is faintly irregular. When viewed from the side the distal end appears flat on top. The edges of the furrowed depression are faintly irregular. This element appears to be the primitive type, capable of being modified into the *Citellus-Cynomys* type; and a trend in that direction seems apparent. Length 3.9 mm.

THE CHIPMUNKS

In the chipmunks the baculum is relatively simple and less specialized than in any members of the Sciuridae we have studied except that in the marmots, to which it bears little resemblance, although Tullburg (1899), by inference, indicated the opposite when he said of *Tamias striatus*—"The male sex organs correspond quite closely to those of *Arctomys*" (*Marmota*).

The baculum in this group, especially in *Tamias*, is most like that of the ground squirrels in that the distal end tends to turn up and broaden out, or become spoon-like. It differs from *Citellus* in that the whole element is relatively longer, less widened and appressed at the base, with no terminal projection, and less specialized at the distal end; further, the slight "twist" in the shaft is from the left side.

Of the two genera of chipmunks, *Tamias* and *Eutamias*, the former (fig. 2, G & H) has the most symmetrical and specialized baculum. In *Eutamias*

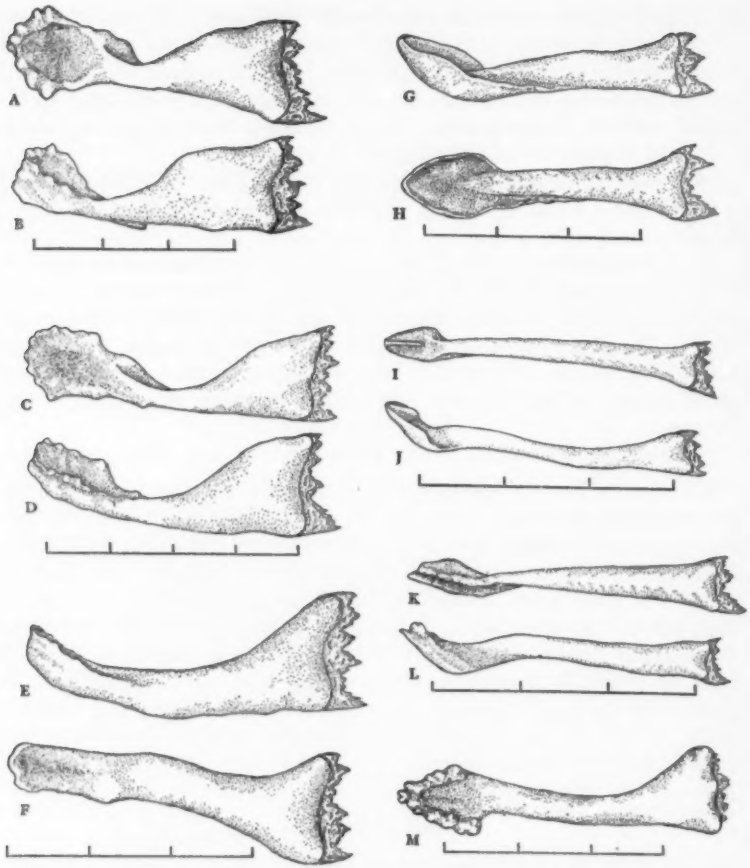


FIG. 2. Views of the bacula of *Cynomys*, *Marmota*, *Tamias*, *Eutamias* and *Citellus* (In each case the scale is divided into millimeters)

A & B	*Cynomys leucurus*
C & D	*Cynomys ludovicianus*
E & F	*Marmota flaviventris*
G & H	*Tamias striatus*
I & J	*Eutamias amoenus*
K & L	*Eutamias minimus*
M	*Citellus variegatus grammurus*

(fig. 2, I, J, K & L) there is obviously great variation in development among the species as indicated by our limited material and by that of the species described and figured by Howell (1938, p. 46; pl. 13, C, E and F).

Tamias striatus (Linnaeus). The baculum of this species (fig. 2, G & H) is widened at the base and the distal end is developed into a "spoon," and rather pointed, slightly upturned. The shaft is furrowed on the left as it extends noticeably into the "spoon." A slightly twisted effect is realized. This "furrow" is due more to a lateral expansion continuous with the spoon than to a depression in the shaft; except for this the shaft is straight. Length 3.7 mm. (of the specimen used in the drawing; we have a specimen, with certain irregularities, measuring almost 5 mm.).

Eutamias amoenus (Allen). In this species the baculum (fig. 2, I & J) is relatively long and slender, nearly straight, and only slightly widened at the base. The distal end is peculiar in that the shaft is modified into a keel-like structure, high at the tip, with a sharp, straight edge; from this the sides are slightly expanded. On each side of the "keel" there is a very shallow depression; on the left this is most pronounced. Length 3.7 mm.

Eutamias minimus (Bachman). The baculum of this species (fig. 2, K & L) also appears long and slender. It tapers rather evenly from the broadened proximal end to the distal end, where the shaft is very narrow and conspicuous between slight lateral expansions. Scarcely any concavity exists, and each expanded side is pointed. There is much variation in this last feature. Our figure is of one with the left side conspicuously pointed. Length 3.5 mm.

THE RED SQUIRRELS

Among the arboreal squirrels this genus constitutes a noteworthy exception in the total absence of the baculum. Apparently unknown to Thomas, this fact was noted by Pocock in specimens he had of *Tamiasciurus hudsonicus*, and we have found it is also true of *T. fremonti* (fig. 3, E). Because of this marked difference Pocock accorded *Tamiasciurus* generic rank, a view not generally accepted, by American mammalogists at least. Mossman (1932, pp. 119–132) has given a detailed description and figures of the male reproductive tract of the red squirrel, pointing out the characters that differentiate *Tamiasciurus* generically. Howell (1938, p. 51) allowed *Tamiasciurus* generic rank and mainly for the same reason as did Pocock and Mossman. Quoting Howell: "Although the red squirrels exhibit no very marked cranial differences from the other tree squirrels, the reproductive tract of the males is strikingly different from that of their relatives in the genus *Sciurus*. They have no baculum, and the penis is long and slender, tapering to a point." This part of the penis of *T. fremonti* is of tough, fibrous structure with no evidences of ossification and without traces of cartilage. It is long, slender and tapering, and conforms closely to that of *hudsonicus* as described and figured by Pocock (1923). From reports, the same condition apparently exists in *T. douglasii* Bach. but we have had no specimens to examine. This structure described for the red squirrels, we take to be the homolog of the part which ossifies and is known as the os penis or baculum in other groups. It occupies the same position and bears the same relationship to the other parts, being ensheathed in soft tissues (prepuce), and distinct at its base from the proximal portion of the penis. The red squirrels then appear to us to have the least specialized and probably the most primitive type of penis of all the Sciuridae, a condition, we believe, that justifies their assignment to full generic rank. Length 37 mm.

THE TREE SQUIRRELS

In the genus *Sciurus* there is a well developed and distinctive baculum. This bone is an elongated, rod-like element, thickest at its base, and terminating distally in an abruptly expanded disc or blade-like structure with the edges dorsal and ventral (or nearly so) in position. The edge beneath bears a tubercle which may be a prominent, sharp projection in some species and quite inconspicuous in others. An unusual structure, apparently hitherto unnoticed, was found to be continuous with a ridge or crest on the left side

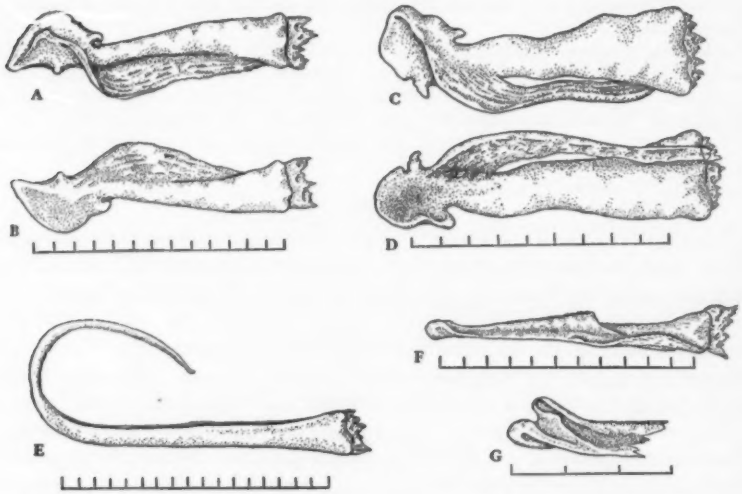


FIG. 3. Views of the bacula of *Sciurus* and *Glaucomys*, and penis of *Tamiasciurus*
(In each case the scale is divided into millimeters)

A & B *Sciurus aberti*
C & D *S. carolinensis* and *S. niger*
E *Tamiasciurus fremonti*
F & G *Glaucomys volans*

of the distal expansion, as if fused to it, as shown in fig. 3, A, B, C & D. (We have shown it partly separated from the periosteum of the shaft in C and D.) This portion is prolonged backward as a curved, band-like strip, paralleling and attached to the underside of the shaft at its base, where the strip is anchored in the soft tissues. In young males it is a fibrous growth, easily detached from the crest of the disc and lost when the bone is dissected free from the soft tissues. In fully matured males, however, it ossifies at its union with the disc where it becomes firmly ankylosed with the ridge. In some specimens the ossification extends backward along a third to a half

the extent of the band, the rest of the band remaining a dense, tough, fibrous tissue. Since this structure partly ossifies, is distinct from the soft tissues, and firmly attaches to the distal part of the baculum proper, it appears to be a true part of the os penis.

Modifications of the distal end of this element have occurred along two lines apparently. In *Neosciurus* and *Parasciurus* (C, D) the edges have been so rolled over as to produce a shallow depression on the right side. The baculum of *Sciurus* is essentially the same in this development, according to Thomas (1915, p. 384), who described this element in *Sciurus vulgaris* as being "like a small spatula, or still more like a half-closed human right hand, the shaft forming the forearm, the blade of the spatula the hollowed palm, and a small pointed projection on the right side corresponding to an outstretched thumb." If the right hand is held in the manner indicated and then rotated to the right so that the thumb is pointing acutely downward this description is essentially correct.

In examining the bacula of the eastern gray squirrel, *Sciurus carolinensis* (subspecies *carolinensis* and *leucotis*) and the fox squirrel, *S. niger* (subspecies *niger* and *rufiventer*), we have found that they are so alike that the differences are no greater than the individual ones that can be found within a species. The drawings in figure 3, C & D illustrating this type, were constructed largely from bacula of fox squirrels; but they represent that of *S. carolinensis* equally well. Pocock (1923) refers to the similarity of this structure in these two species and states that they are of the type of *Sciurus vulgaris*. The figures he used to illustrate this type were made from the baculum of *S. niger*. His figures are not entirely typical because they do not show the peculiar band-like development on the convex side of the disc. This bone is smaller in the *carolinensis* group than in the *niger* group as a general rule, but this does not hold true when compared with *rufiventer*, which is actually smaller. Following are length measurements of the largest baculum we have of each subspecies, each from a fully matured animal: *S. c. carolinensis*, 11.2 mm.; *S. c. leucotis*, 12.4 mm.; *S. n. niger*, 13.3 mm.; *S. n. rufiventer*, 11.3 mm.

The other line of development showing distinctive modifications of the distal end is seen in the subgenera *Otosciurus* and *Hesperosciurus*. Here the expanded distal part is blade-like with a pointed tip, instead of being broadly rounded. The sharp edge of the blade is up, and while there may be a faint depression on the right surface it is not a pronounced concavity as noted in the first type. Further, the "blade" is prolonged backward over the neck of the shaft as a sharp projection. In the first type (*Neosciurus* and *Parasciurus*) such a projection is present but it is usually blunt and farther away from the shaft.

No specimens have been available for study from the western form, *Sciurus griseus*, and our knowledge is limited to the information supplied by Howell (1938, p. 49; pl. 13, V) to which we have referred in formulating this discussion.

We have bacula (fig. 3, A & B) of the tuft-eared squirrel of Colorado, *Sciurus aberti* (subspecies *ferreus*). In this race the baculum is straight, long and slender; tapering evenly from the broad base to the much narrower "neck" where the "blade" begins. The band-like strip arising from the left side is present and well developed. It differs from the first type in its attachment at the distal end in that this attachment is continuous with a folded over "flap" of the under edge which is closely applied to the side of the "blade." Through this folded margin is projected the tubercle. The length of the largest specimen in our collection is 15.1 mm.

The baculum in the *griseus* group has apparently undergone greater modification and specialization than in the *aberti* group, but in the same direction.

Of the two types of bacula (the *Neosciurus-Parasciurus* type and the *Otosciurus-Hesperosciurus* type) the first appears to be the more specialized. It is probably a modification of the second type, which, although specialized differently, would seem to be nearer the primitive condition.

The bacular structure indicates affinities relating the eastern gray squirrels and the fox squirrels on the one hand and the tuft-eared squirrels and the western gray squirrels on the other.

THE FLYING SQUIRRELS

Glaucomys volans (Linn.), the species studied, in keeping with its great degree of specialization as an arboreal squirrel and its general distinctive bodily features, has a baculum (fig. 3, F & G) fully as characteristic. It is a complex, greatly specialized structure, modified in ways quite different from other sciurids. It is long, slender, and with a tip very little expanded but, instead, produced into a knob, which, when viewed from the end, appears to be bilobed. A narrow and shallow furrow extends the full length of the shaft and onto the most proximal lobe of the knobbed end. This furrow lies mainly on the right surface, and is not quite straight or uniform in the proximal third of its course, where it curves below the semi-circular border of a patch of slick, fibrous tissue, closely adhering and appressed to the bone. The free edge of this peculiar growth is weakly serrate throughout most of its extent. At its base is a second, smaller area of similar nature, also with a serrated border, slightly overlapping the first. In the distal half, or slightly more, of the shaft, on the lower side of the furrow, there is a narrow blade-like flange with a prominent, slightly serrate base where the blade is widest. The entire baculum lacks symmetry. The figure by Howell (1938, pl. 13, X) of this type of baculum does not agree fully with the material available to us.

Using the baculum as a criterion it would indicate, for this group, a relationship relatively remote from our other arboreal squirrels. Length 12.6 mm.

[Studies from the Zoological laboratories of the University of Nebraska, No. 205.]

LITERATURE CITED

ANTHONY, H. E. 1928. Field book of North American mammals. G. P. Putnam's Sons, New York, pp. xxv + 625, figs. 151, pls. 48.

BURT, W. H. 1936. A study of the baculum in the genera *Perognathus* and *Dipodomys*. Jour. Mamm., vol. 17, no. 2, pp. 145–156.

HOWELL, A. H. 1938. Revision of the North American ground squirrels with a classification of the North American Sciuridae. U. S. Dept. Agric. North Amer. Fauna, no. 56, 256 pp.

MOSSMAN, H. W., JOHN W. LAWLAH, AND J. A. BRADLEY. 1932. The male reproductive tract of the Sciuridae. Amer. Jour. Anat., vol. 51, no. 1, pp. 89–155, fig. 16, pls. 1–7.

POCOCK, R. I. 1923. The classification of the Sciuridae. Proc. Zool. Soc. London, pp. 209–246.

THOMAS, O. 1915. The penis-bone or "baculum" as a guide to the classification of certain squirrels. Ann. Mag. Nat. Hist., ser. 8, vol. 15, pp. 383–387.

TULLBERG, T. 1899. Ueber das System der Nagethiere; eine Phylogenetische Studie. Nov. Acta. Reg. Soc. Upsal., ser. 3, vol. 18, pp. 329–541, 1900.

University of Nebraska, Lincoln, Nebraska.

WEIGHING LARGE MAMMALS IN THE FIELD

BY J. KENNETH DOUTT

Accurate knowledge concerning the weights of large mammals is decidedly limited. One of the reasons for this lack of knowledge is the difficulty of carrying into the field an instrument suitable for weighing such mammals. Several types of scales are on the market; but frequently the hunter or collector finds himself away from camp with a large animal that must be skinned on the spot. A very real problem then presents itself.

On March 22, 1938, I was on Lower Seal Lake, about 120 miles inland from the east coast of Hudson Bay. I had a freshly killed seal that I wanted to weigh. The only scales I had was a spring balance that weighed up to 25 pounds, so I proceeded as follows: I set up a tripod of poles and from the center of the tripod I suspended a single long pole. The rope which acted as a fulcrum was tied very close to one end of this pole, as shown in figure 1. I suspended the seal on the short end of the pole 24 inches from the fulcrum. Even at the very opposite end of the pole, however, my spring balance was not strong enough to register the force. I filled a kettle with water until the kettle and the water together weighed 21 pounds. This combination I suspended at a distance of 9 feet, 5 inches from the fulcrum on the end of the pole opposite the seal. At this same point I attached the spring balance. It registered an additional pull of 22½ pounds. After recording these measurements of distance and weight I removed the seal and the kettle of water and placed the scales on the pole in the position where the seal had been suspended.

The scales here registered a weight of 17 pounds, indicating that the pole itself exerted a lifting force of 17 pounds on the seal. Adding the weight of the kettle and water, 21 pounds, and the weight on the balance, 22½ pounds, I had a total force of 43½ pounds required to balance the seal. The seal was 24 inches from the fulcrum, the counter balance was nine feet five inches from

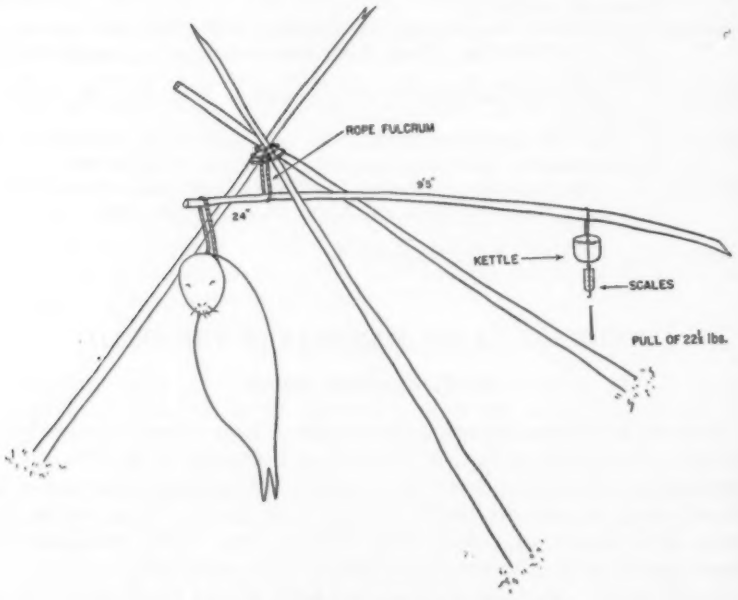


FIG. 1. Device for weighing large mammals

the fulcrum, and thus the weight of the seal became a simple matter of proportion:

$$24:113 = 43\tfrac{1}{2}:x$$
$$24x = 4915.5$$
$$x = 204.8$$

The pole itself exerted a lifting force of 17 pounds at the point where the seal was suspended, so this 17 pounds added to the weight calculated above made a total weight for the seal of 221.8 pounds. Allowing for some inaccuracy due to the crudeness of the method, it would still be safe to say that the seal weighed between 210 and 230 pounds.

On another occasion, in the mountains of Arizona, I wanted to weigh a deer that I had killed. Although I had no balance, I used the same system, ex-

cept that I filled a five gallon canteen with water until it balanced the deer. Then I measured the water in the canteen. Likewise, I measured the amount of water required to balance the pole when the canteen was suspended in place of the deer. I made records of the distances and weights as before and when I got back to town a few days later I weighed the empty canteen on a platform scales. Water weighs approximately eight pounds per gallon, so again it was a simple matter of arithmetic to calculate the weight of the deer in the same manner as described for the seal.

A five gallon desert water bag, or a folding canvas bucket of similar capacity would weigh less than one pound. Such a light container, a measuring cup or some other receptacle for measuring accurately the amount of water used, and a pocket tape, combined with the simple tripod method described here, would be sufficient to weigh most of the larger North American mammals.

In the Journal of Mammalogy, vol. 9, pp. 74 and 75, February 1928, O. J. Murie presents some very valuable suggestions concerning the weighing of large mammals. Some of these suggestions are so much to the point that I here take the liberty of quoting them:

"In seeking information in literature on the weights of game animals, many records are found to be almost useless because insufficient data are given. To make such records most useful several definite facts should be furnished:

1. It should be stated whether given weight was estimated or the animal was actually weighed.

2. The sex and approximate age of the animal should be noted. Among ungulates differences in weight are very noticeable between the sexes, between a yearling and an older animal, or between a young adult male and one that has reached its greatest development.

3. It should be stated whether the figures given refer to live weight or dressed weight. One might assume that ordinarily the live weight is intended, but quite often the animal is weighed after dressing. Hence, unless this information is furnished the record is ambiguous.

4. The date of killing has a definite value. Generally the condition of the animal varies greatly with the seasons. An animal, especially a male, killed before the rut in fall will weigh much more than one killed after the rut in winter.

In weighing a large animal it is generally almost impossible to suspend the entire carcass without other equipment. My own practice was to cut up the animal and weigh the pieces. The dressed weight included the carcass without head and with feet cut off at the usual place, just as the animal would be handled in a meat market, without the hide. The live weight was obtained by gathering entrails, feet, and all other parts, into a gunny sack or other available material and weighing separately. The total of all pieces would give the live weight, although there is a certain amount of error due to the loss of blood.

At best it is difficult to obtain absolutely accurate weights in the field. Equipment and methods of operation must depend on individual ingenuity and enthusiasm. But in any case there should be no question as to the need for full information with the figures given in order that recorded weights may be of the greatest use."

Carnegie Museum, Pittsburgh, Pennsylvania.

GROSS ANATOMY OF THE ORBITAL GLANDS IN THE ALBINO RAT

By John H. Venable and Allan L. Grafflin

The present report is preliminary to a microscopic study of the Harderian gland in the albino rat. For the purposes of the latter study it became essential to have accurate knowledge of the gross anatomical relationships not only of the Harderian gland, but also of the two other major orbital glands. Search of the literature revealed the lack both of a well-knit description of the glands, and of satisfactory illustrations. The most recent figures available are those of Greene (1935), which do not give an adequate conception of the extent and relationships of the Harderian gland, in which we have been most interested. Under the circumstances we have undertaken a re-description of the glands, and have prepared a group of new illustrations, based upon dissections of adult Wistar rats. These dissections were carried out on fresh and formalin-fixed (immersion and perfusion) specimens.

Dissection of the lateral face and orbit of the albino rat reveals three major orbital glands: 1) the external orbital gland (first described and named by Loewenthal, 1900; designated 'exorbital lacrimal gland' by Greene, 1935); 2) the infraorbital gland (first described and named by Loewenthal, 1895; designated 'intraorbital lacrimal gland' by Greene); and 3) the Harderian gland. In this report Loewenthal's terminology, which has been adopted by Franz (1934), will be used in preference to that of Greene. Figure 1 illustrates the superficial relations of these three glands on the right side. In the following description the terms superior, inferior, medial and lateral refer to the four arms of a cross drawn through the center of the cornea parallel to the plane of the iris.

External orbital gland.—The external orbital gland (e.o.g.) is a flattened, pyriform disc lying just below the ear, with its long axis perpendicular to the zygomatic arch. The deep surface of the gland (not illustrated) lies, from above downward, on the temporal muscle (t.m.), the zygomatic process of the squamous temporal bone, and the superficial portion of the masseter muscle. The duct arises at the upper part of the anterior border of the gland, and runs forward across the temporal muscle directly to the outer part of the upper eyelid. Just before reaching the lid this duct is joined by the duct of the infraorbital gland (i.g.); and the common duct, passing through the outer portion of the upper lid, opens into the outer part of the superior conjunctival fornix.

Infraorbital gland.—The infraorbital gland (i.g., fig. 1) lies within the orbit in the triangular space bounded below by the zygomatic arch, above by the duct of the external orbital gland, and in front (medially) by the bulbus oculi. From its triangular outer surface the gland extends deeply to an apex which occupies the space between the subjacent Harderian gland and the superolateral wall of the orbit (formed by the temporal muscle). The external

triangular surface lies just deep to the lateral palpebral fascia, which limits the orbit superficially. (This fascia is not represented in figure 1 as it had been removed to expose the orbital contents.) From the anterior (medial) part of the superior border of the gland the duct runs forward and upward for a short distance to join the duct of the external orbital gland.

FIG. 1. Dissection illustrating the superficial relations of the three orbital glands, on the right side. Approximately × 1½. See text.

Harderian gland.—The Harderian gland lies for the most part deep within the orbit. However, the external rim of the gland extends forward into the space between the bulbus oculi and the orbital rim, and can be seen as soon as the palpebral fascia has been removed from its orbital attachment (fig. 1). At the level of dissection illustrated in the figure, this rim of the Harderian gland encircles the superior, medial and inferior fourths of the circumference of the bulbus oculi. More deeply (fig. 2) the gland extends for at least seven-eighths of the bulbar circumference. As is well known, the Harderian gland is intimately associated in its development with the nictitating membrane,

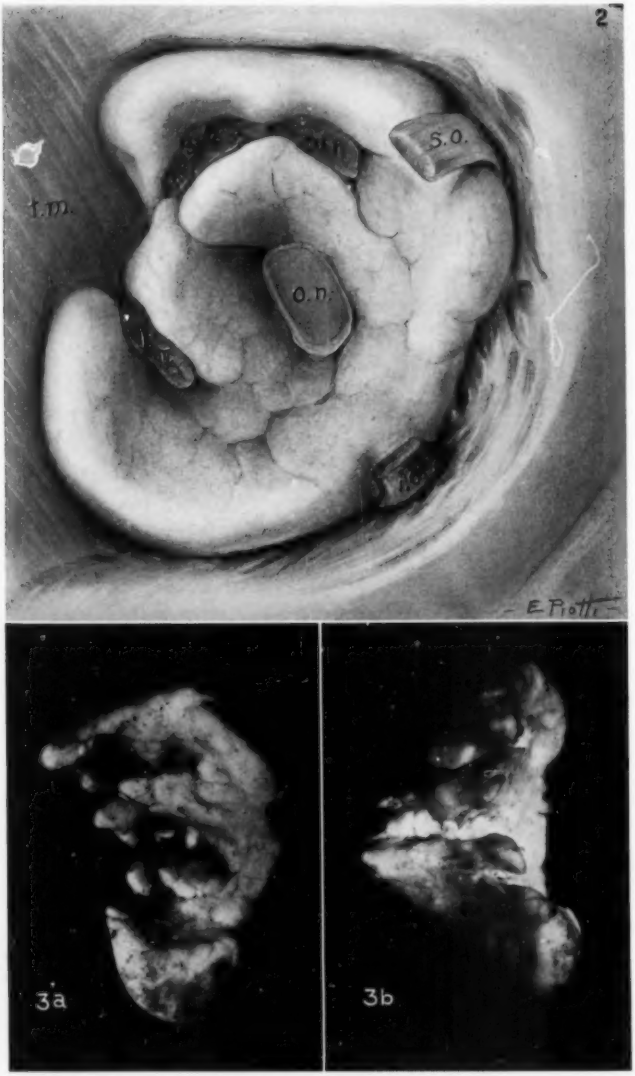


FIG. 2. The Harderian gland, likewise on the right side and oriented as in fig. 1, after removal of the bulbus oculi and the infraorbital gland. Approximately × 9. See text.

FIG. 3. Two photographs of the entire Harderian gland, from the right orbit. a—This view is essentially equivalent to that given in figures 2 and 4. b—This view is at right angles to a. Approximately × 4. See text.

at the base of which it empties its secretion into the conjunctival sac. When the dissection is carried out under a dissecting microscope, the small excretory ducts can be readily observed. A striking fact, not evident in the illustrations, is the almost complete absence of orbital fat.

Two of the extra-ocular muscles cross in front of the Harderian gland in approaching their bulbar attachment (figs. 1 and 2). The superior oblique muscle (s.o.), after its acute change of direction at the trochlea, passes in front of the superomedial portion of the gland on the way to its superomedial bulbar attachment. The inferior oblique muscle (i.o.) appears anteriorly between the gland and the inferior rim of the orbit, and turns—not as acutely as the superior oblique—in front of the gland to pass to its inferior bulbar insertion. In preparations fixed in situ there are depressions on the gland surface which indicate the close relationship of the muscles to the gland (figs. 1 to 4; best shown in figs. 1 and 2).

After removal of the bulbus oculi and the infraorbital gland, the extent of the Harderian gland may be more fully appreciated. Figure 2 represents the orbital structures after such a procedure, the optic nerve and the extra-ocular muscles having been cut as near the bulbus as possible. The Harderian gland exhibits a hemispherical depression into which the posterior hemisphere of the bulb normally fits. The shape and relationships of the gland are so well shown in the figure that no lengthy description is necessary. The gland mass is continuous medially (to right in figure), but more laterally (center and left of figure) is subdivided by three clefts, through which pass the optic nerve (o.n.), the levator palpebrae superioris (l.p.s.) and the extra-ocular muscles (superior rectus—s.r., medial rectus—m.r., and lateral rectus—l.r.). It is obvious that the shape of the gland is due to its development in relation to these structures. The two arms of the gland surrounding the optic nerve overlap laterally, but do not fuse; the superior and inferior arms of the gland are separated laterally by an appreciable gap. As indicated in figure 2, the Harderian gland is closely related to the walls of the orbit, except where separated by the oblique muscles, and this relationship persists as far as the apex of the orbit. The temporal muscle (t.m.) forms part of the orbital wall, and consequently comes into relation with the corresponding deep aspect of the gland.

Two photographs of the right Harderian gland, fixed in situ by perfusion with formalin and carefully dissected in toto, are presented in figure 3. The view in figure 3a is essentially equivalent to that in figure 2. The optic nerve and extra-ocular muscles have been removed, and the shape of the gland, with its three clefts, is well shown. To obtain the view in figure 3b, the gland was rotated through 90°, so that we are looking directly into the groove normally occupied by the optic nerve. This figure clearly illustrates the conical shape of the deeper portion of the gland, which extends to the apex of the orbit.

Figure 4 is a line drawing of the same Harderian gland illustrated in figure 3, and is oriented essentially the same as in figures 2 and 3a. The groove for the optic nerve, and the clefts through which pass the extra-ocular muscles, are readily apparent.

The large size of the Harderian gland in the rat is evident in the illustrations, and is further emphasized by a comparison of its weight with that of other glands in the body. For example, the gland illustrated in figures 3 and 4 weighs 200 milligrams (preserved in formalin, surface dried with filter paper). The weight of both glands would then be approximately 400 milligrams, for a 205 gram female specimen, or about 0.2% of the body weight.

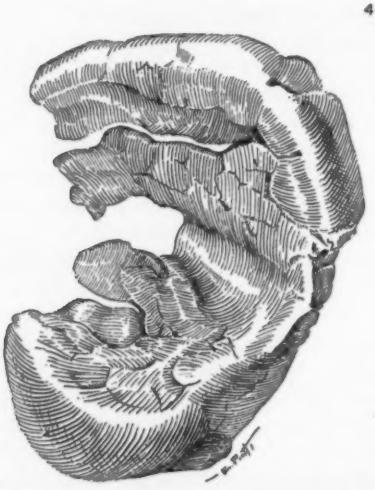


FIG. 4. Camera lucida drawing of the same Harderian gland illustrated in figure 3. Oriented as in figures 2 and 3a. Approximately × 6. See text.

Making use of Donaldson's (1924) tables, this means that the weight of the two Harderian glands is approximately equal to that of the submaxillary glands, and is roughly two-fifths of that of the pancreas. The glands are almost half again as heavy as the eyeballs.

Abundant references to the extensive literature on the orbital glands of the rat and other mammals can be found in the recent treatise by Franz (1934).

LITERATURE CITED

DONALDSON, H. H. 1924. The rat. Data and reference tables for the albino rat and the Norway rat. Mem. Wistar Inst. Anatomy and Biology, no. 6, 2nd ed.

FRANZ, V. 1934. Vergleichende Anatomie des Wirbeltierauges. In: Handb. vergl. Anat. Wirbeltiere, edited by L. Bolk et al., vol. 2, pp. 989–1292.

GREENE, E. C. 1935. Anatomy of the rat. Trans. Amer. Phil. Soc., Philadelphia, n.s., vol. 27.

LOEWENTHAL, N. 1895. Zur Kenntnis der Glandula infraorbitalis einiger Säugetiere. Anat. Anz., vol. 10, pp. 123–130.

——— 1900. Drüsenstudien. II. Die Gl. infraorbitalis und eine besondere der Parotis anliegende Drüse bei der weissen Ratte. Arch. f. mikr. Anat., Bd. 56, S. 535–552.

[The senior author is a member of the Department of Anatomy, Emory University, and a fellow of the Commonwealth Fund.]

Department of Anatomy, Harvard Medical School, Boston, Massachusetts.

DISSECTION OF THE THYROID AND PARATHYROID GLANDS IN AN ADULT MOUNTAIN GORILLA

BY JOHN H. VENABLE AND ALLAN L. GRAFFLIN

In the absence of any previous report upon the gross anatomical relationships of the thyroid and parathyroid glands in the gorilla, a dissection of these glands has been carried out upon an adult male specimen of the mountain gorilla (*Gorilla gorilla beringei*). The animal was shot in November, 1938, by the McGill University Congo Expedition, under the leadership of Mr. Duncan M. Hodgson, in the mountains of the Eastern Belgian Congo (30 kilometers south of Lubero); and after partial dissection the tissues were fixed by immersion in 5% formalin, in which they were received by us in June, 1939. The specimen is designated as field no. 74, Museum of Comparative Zoology no 38017. The chest circumference is 1439 mm., the height (heel to top of head) 1693 mm.; and from complete measurements, and from comparison with Raven's data (Coolidge, 1936) upon a mountain gorilla of known weight, Dr. Harold Coolidge estimates the weight as close to 450 pounds.

The gross anatomical relationships of the thyroid and parathyroid glands on the left side are illustrated in figure 1. The thyroid consists of a thin isthmus and two symmetrical lateral lobes. The thin isthmus is located just below the inferior border of the cricoid cartilage, surrounding the upper end of the trachea; its level is higher than that of the same structure in man. As shown in the figure, the isthmus fuses smoothly with the lateral lobe, which has no free inferior pole such as characterizes the human thyroid. It is striking that the lateral lobes extend so far posteriorly that they lie in part upon the posterior surface of the pharynx.

The thyroid is supplied, on each side, by a superior and an inferior thyroid artery. The superior artery runs parallel to the medial (anterior) border of the lateral lobe, and is somewhat larger than the inferior artery, whose branches ramify over the deep surface of the gland. The origin of the superior

vessels is not included in the specimen. The left inferior artery arises from the common carotid more than an inch above its origin, and passes upward in front of the recurrent laryngeal nerve to reach the thyroid near the junction of the isthmus and the lateral lobe. The right inferior artery has a similar course, but it arises from the subclavian artery immediately beyond the origin of that vessel. All four thyroid arteries are accompanied by veins; in addition, there are middle thyroid veins on each side.

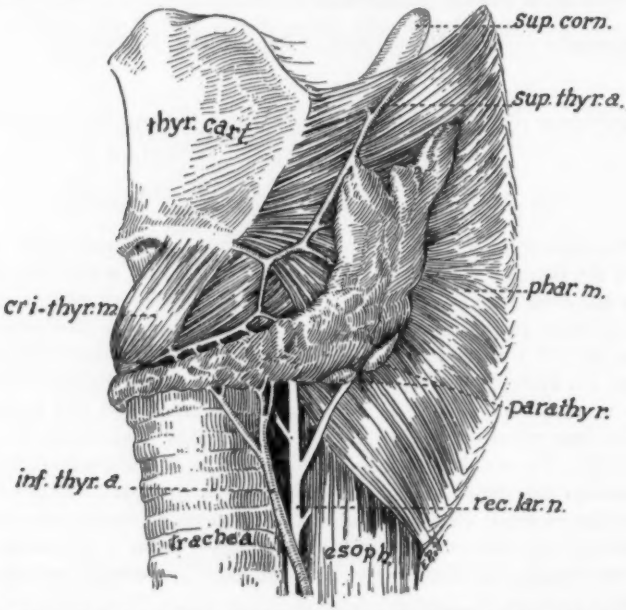


FIG. 1. Dissection of the thyroid and parathyroid glands, on the left side, in a mountain gorilla. ¾ natural size.

On the left side there are two parathyroid glands, one about twice the size of the other, and located as shown in the figure. On the right side only one parathyroid could be found, and it is located in approximately the same position as those on the left. Each of the parathyroids on the left side is supplied by a distinct branch of the inferior thyroid artery, and the single gland on the right side has a similar arterial supply.

The weight of the thyroid and parathyroid glands combined (removed from formalin, surface dried with filter paper, capsule of thyroid gland stripped) is approximately 11 grams.

LITERATURE CITED

COOLIDGE, HAROLD J. 1936. Zoological results of the George Vanderbilt African Expedition of 1934. Part IV. Notes on four gorillas from the Sanga River region. Proc. Acad. Nat. Sci. Philadelphia, vol. 88, pp. 479–501.

[The senior author is a member of the Department of Anatomy, Emory University, and a fellow of the Commonwealth Fund.]

Department of Anatomy, Harvard Medical School, Boston, Massachusetts.

ON MALAY PIGS OF THE SUS VERRUCOSUS GROUP

BY ERNST SCHWARZ

In 1897, Forsyth Major described, as *Sus verrucosus borneensis*, a skull of a wild boar from Borneo in the collection of the British Museum. No other specimen of this type has since been recorded from Borneo. The fact of the occurrence of *Sus "verrucosus"* on the island appeared rather remarkaable, as the group is represented there by the form known as *Sus barbatus* Müller.

Recently a skull from Lampong, Sumatra, in the Zoological Museum, Munich, similar to the one described by Forsyth Major, has been described and figured as a new subspecies, *Sus verrucosus sumatranus*, by Kelm (1939).

Each of these skulls has a shorter face, broader forehead, and wider occiput than the Sumatran and Bornean forms of *"barbatus"*; they even exceed in this respect the normal type of *verrucosus* from Java. It so happens that the U. S. National Museum has a skull from Binoeangan, West Java (U. S. N. M. No. 156494, ♂ ad.) which differs from typical old male skulls of the Javan *Sus verrucosus verrucosus* Müller and Schlegel in much the same way, although not quite to the same degree, as the skulls described by Forsyth Major and Kelm differ, respectively, from the Bornean and Sumatran *"barbatus."*

The Sumatran and Bornean forms of *barbatus* agree in having the nasals and forehead rather flat, in this character differing from the Javan *"verrucosus,"* where these parts are more rounded above, and the cross-section is not almost flat on top, but distinctly convex.

The cheek teeth have reduced styles in the Sumatran and in the Bornean animals, in contrast to the Javan form. Also in the Bornean and Sumatran skulls the posterior end of the post-canine crest has a tendency to form an obtuse angle with the maxillary, whereas, in the Javan skulls this angle is almost a right angle.

If, with these premises established, the description and figures published by Kelm are compared, it is obvious that both Kelm's *sumatranus* and Forsyth Major's *borneensis* (as figured by Kelm) have all the main characters typical of the Sumatran and Bornean *"barbatus,"* and that they represent

short-faced indivdual types of *oi* and *barbatus*, respectively, just as the skull of the Javan animal at Washington is a short-faced type of *verrucosus*. Both the Sumatran and Bornean skulls figured by Kelm have the flat nasals and forehead, the obtuse angle between the post-canine crest and the maxillary; and the type of Kelm's *sumatranus*, according to his description, has the reduced styles in the cheek teeth typical of *oi*. There cannot be, therefore, any doubt that *borneensis* is a synonym of *barbatus* and *sumatranus* a synonym of *oi*.

Shortened faces are not uncommon in individuals of mammals which normally have the facial part of the skull unusually lengthened. Lengthening of this part of the skull begins at a relatively advanced stage of growth, and is stopped prematurely, if the process of growth in an individual is not carried to its normal end. When this happens we find skulls which, at first glance, appear to differ essentially from those of the bulk of the population to which they belong. I have seen skulls of this type in all kinds of mammals with extremely long faces, such as various types of pigs, hartebeests, and baboons.

It would appear to me that the Malay pigs in general can be divided into two major groups, namely, the *Sus scrofa* type, of which *vittatus* and its local forms are representative, and the *verrucosus* type. All the forms of the second group I am inclined to regard as local subspecies of *Sus verrucosus* Müller and Schlegel. The more important ones are: *oi, barbatus, verrucosus, philippensis, celebensis*. This would mean that in the present connection we have to deal with the following names:

Sus verrucosus verrucosus Müller and Schlegel, Java
Sus verrucosus oi Miller, Sumatra
Sus verrucosus barbatus Müller, Borneo

A comparison of the ratio of zygomatic width to basilar length, as shown in the accompanying table, gives a good idea of the relative elongation of these skulls. It makes it clear that *S. v. oi*, *S. v. barbatus* and, third in decreasing order, *S. v. verrucosus* have rather long skulls whereas the smaller insular types found in the Lesser Sunda Islands, the Philippines and Celebes, have the face still more elongated. The two outstanding skulls from Sumatra and Borneo described above, approach the smaller insular type more closely than they do the normal Javan type.

Another variation occasionally found in these pigs is the elongation of the occiput. In the table I have indicated where an occipital overhang is found; from this it is obvious that the relative length of the occipital overhang varies independently of the relative length of the facial part of the skull (see table on next page).

I believe that the skull described by Miller (1906) as *Sus gargantua* is a very large individual of *Sus verrucosus barbatus* with a pronounced occipital overhang. Before me is a similar specimen of *S. v. oi* from Pulau Tebing Tinggi, off the east coast of Sumatra (U. S. N. M. no. 144312, old ♂) which,

Skulls of members of the Sus verrucosus group

SPECIMEN	SUBSPECIES	BASILAR LENGTH[1]	ZYGOMATIC WIDTH	ZYGOMATICO-BASILAR RATIO	OCCIPITAL OVERHANG
USNM 113150 ♂ Indragiri R., E. Sumatra, Type of *oi*	*oi*	390	162	415	−
USNM 144312 ♂ Pulau Tebing Tinggi, E. Sumatra	*oi*	390	151	387	+
USNM 144354 ♂ Pulau Rangsam, E. Sumatra	*oi*	370	160	459	−
Munich Museum ♂ Lampong, S. Sumatra Type of *sumatranus*	*oi*	340	179	526	+
USNM 34891 ♂ Sandakan, N. Borneo.	*barbatus*	376	148	396	−
Berlin Museum ♂ S. E. Borneo[2] Type of *gargantua*	*barbatus*	440	185	420	+
British Museum 59.8.16.5 ♂ Type of *borneensis*	*barbatus*	318	174	547	+
USNM 156494 ♂ Binoeangan, W. Java.	*verrucosus*	295	150	508	+
USNM 155342 ♂ Bantam, W. Java....	*verrucosus*	315	155	492	−
USNM 113247 ♂ Mindoro, P. I.....	*philippensis*	287	152	529	+

[1] All absolute measurements in mm.

[2] Exact locality: Kapoeas River (Nehring 1885); specimen formerly in the Agricultural High School.

in the occipital overhang, agrees with the type of *S. gargantua*. It will be seen from the table that this last specimen, the skull from Tebing Tinggi, and the type specimens of *sumatranus* and *borneensis* exhibit a similar occipital overhang, although they differ widely from one another in facial length.

LITERATURE CITED

KELM, H. 1939. Ein Pustelschwein von Sumatra. Zool. Anz., vol. 125, pp. 219–224, figs. 1–6. March 15, 1939.

MAJOR, C. I. FORSYTH. 1897. On *Sus verrucosus*, and allies, from the Eastern Archipelago. Ann. Mag. Nat. Hist., ser. 6, vol. 19, pp. 521–542. May 1, 1897.

MILLER, G. S., JR. 1906. Notes on Malayan pigs. Proc. U. S. Nat. Mus., vol. 30, pp. 736–758, pls. 39–64. June 13, 1906.

NEHRING, A. 1885. Über eine neue Art von Wildschwein (*Sus longirostris* Nehring) aus Südost-Borneo. Zool. Anz., vol. 8, pp. 347–353. June 15, 1885.

Washington, D. C.

THREE NEW MAMMALS FROM ASIA

By H. Harold Shamel

During a rearrangement of the U. S. National Museum collection the following new mammals have been discovered.

Rattus melanurus sp. nov.

Type.—Adult male skin and skull, no. 197371, U. S. N. M., collected at Pulo Miang Besar, just out from Sangkulirang Bay, Borneo, September 12, 1913, by H. C. Raven.

Geographic distribution.—Known only from the Island of Miang Besar.

Diagnostic characters.—A small spiny rat of the *Rattus rajah* group with dark, velvety belly fur, free from spines, and a uniformly dark tail, both above and below.

Color.—Back of head dark wood brown; spines on rump longer and lighter in color than those on the back. The belly hair at base is a dark smoky gray, very short and soft and free from spines; the entire under side is washed with tawny. Underside of front legs grayish. Tail dark brown above, scarcely lighter below. All four feet washed with tawny.

Skull.—The skull is easily distinguished, by its much smaller size, from skulls of either *Rattus perflavus* or *Rattus ubecus*, two other island forms off the southeast coast of Borneo, as well as from all other related Bornean forms in the National Museum collection.

Measurements.—Type: head and body, 136.0; tail, 112.0; hindfoot, 28.0; greatest length of skull, 35.0; condylobasal length, 31.0; interorbital constriction, 6.0; zygomatic breadth, 16.0; breadth of braincase, 15.0; length of nasals, 12.0; length of upper toothrow, 5.2; length of lower toothrow, 5.0.

Specimens examined.—Three skins with skulls, all from the type locality. The skins all match each other in every detail.

Remarks.—The short dark gray belly hairs, the absence of spines on the underside, and the dark unicolored tail distinguish this rat from other members of the *Rattus rajah* group.

Rattus perasper sp. nov.

Type.—Adult male skin and skull, no. 198255, U. S. N. M., collected at Gunong Batu, Borneo, December 5, 1913, by H. C. Raven.

Geographic distribution.—Known from the following localities on the east coast of Borneo in the region just north of Sangkulirang Bay: Gunong Batu, Labuan Klambu, and Sungai Ritan.

Diagnostic characters.—A member of the *Rattus rajah* group. Color, wood brown on head and back; underparts buffy, more or less washed with rufous, this lighter color spreading to the cheeks, post auricular region, and front legs. The light areas behind the shoulders make two light patches of considerable size which faintly meet across the back. The rufous wash on the underparts is more intense around the throat and neck. Spines unusually numerous both on back and belly. Feet, both fore and hind, covered with short whitish-buffy hairs. Tail decidedly bicolor, dark brown above and whitish underneath.

Skull.—The skull is characterized by its light build and small size. The teeth are smaller than those of other Bornean specimens of the *Rattus rajah* group in the U. S. National Museum collection.

Measurements.—Type: Head and body, 140.0; tail, 151.0; hindfoot, 32.0; greatest length of skull, 38.0; condylobasal length, 34.0; interorbital constriction, 7.0; zygomatic

breadth, 16.0; breadth of braincase, 16.0; length of nasals, 14.0; length of upper toothrow, 5.0; length of lower toothrow, 5.0.

Specimens examined.—Eight, including the type.

Remarks.—The rufous wash on the underparts and the pale area on each shoulder give this rat a distinctive appearance among the Bornean members of the group. The shoulder spot is noticeable in all of these skins except in two females, one adult, the other immature. Two skins are a little darker on the back than the others. The fur is unusually spiny.

Lepus europaeus cinnamomeus subsp. nov.

Type.—Adult male skin and skeleton, no. 255006, U. S. N. M., collected at Suifu, Szechwan, China, December 13, 1929, by D. C. Graham.

Geographic distribution.—Known from the type locality, Suifu, Tseo Gia Keo on the Yunnan border south of Suifu, and Tsong Ku.

Diagnostic characters.—Color darker and more saturate than in any of the neighboring races. It is most nearly approached by *Lepus europaeus aurigineus* from Kiang-si. The fur is rather long and loose, hairs 32.5 mm. long on the back. Distinguished from *Lepus europaeus europaeus* by its shorter hindfoot and ear, and the presence of more black on the back.

Color.—Top of head, back and sides cinnamon-rufous, plentifully mixed with black that gives a coarse grizzled effect; fore and hind legs (except underside of hind legs), chin, and sides of belly clear cinnamon rufous; the individual hairs on the throat with a subapical band of smoky gray which makes the throat less clear in color than the rest of the underparts; belly, inner side of hind legs and underside of tail whitish, the underside of tail more grayish white than belly. A buffy spot on upper lip on each side of cleft and around edge of nostril, another before each eye, and a third between eye and ear; the latter two are more grayish. The outer side of the ear is cinnamon-rufous with a black tip and a somewhat paler edge; the internal edge of the ear is the same color with a dark spot about midway from base to tip; the front edge is like the back except that the grizzling is very much finer.

Skull.—The skull, except for its smaller size, is indistinguishable from that of *Lepus europaeus europaeus*.

Measurements.—Type (skin measurements taken from dry skin): Head and body, 440; tail, 90.0; hindfoot, 115.0; ear, 95.0; greatest length of skull, 87.0; condylobasal length, 77.5; interorbital constriction, 19.0; zygomatic breadth, 41.0; breadth of braincase, 30.5; length of nasals at center, 29.0; postorbital constriction, 12.5; breadth at m^3, 23.5; mastoid breadth, 27.0; length of upper toothrow, 16.0; length of lower toothrow, 16.0; inside depth of orbit, 19.0.

Specimens examined.—Twenty-four, 12 adults and 9 young, from the type locality; two skulls without skins from Tsong Ku; one skin and skull from Tseo Gia Keo, on the Yunnan border south of Suifu. The skins from Suifu were collected in June, July, December, and January. All the adult skins from Suifu are alike in color except a female collected in June, which has a shorter, more finely grizzled coat. The chin in some of these specimens is white rather than buffy as in the type. One other specimen from Tseo Gia Keo, is evidently in summer pelage, though the date of collection is not known. Its fur is quite short, shorter than the June specimen from Suifu, the colors are much paler than the other specimens, and the grizzling is very fine.

Remarks.—Oldfield Thomas, writing "On Mammals from the Provinces of Kan-su and Szechwan, Western China" (Proc. Zool. Soc. London, 1911, p. 180), listed two males and one female of *Lepus sechuenensis* de Winton, a gray tailed hare related to *Lepus oiostolus oiostolus*. At that time he knew no hare "from the typical forested area of Western Sze-chwan." The specimens collected by Doctor Graham represent this ani-

mal. The darker richer color of this subspecies will readily distinguish it from any of its neighboring relatives. It is most like *Lepus europaeus aurigineus* Hollister from Kiangsi.

U. S. National Museum, Washington, D. C.

FOUR NEW ORYZOMYINE RODENTS FROM ECUADOR

By Philip Hershkovitz

I wish to thank the American Museum of Natural History, the Field Museum of Natural History, and the Academy of Natural Sciences of Philadelphia for the loan of specimens. I am especially indebted to Dr. Wilfred H. Osgood for the loan of the unique specimen (type) of *Oryzomys andinus* Osgood, as well as for other material and information. This work was done under the guidance of Dr. William H. Burt, to whom a large share of the credit for it is due.

In the lists of specimens examined the abbreviation A.M.N.H., refers to the American Museum of Natural History; F.M.N.H., to the Field Museum of Natural History; A.N.S.P., to the Academy of Natural Sciences of Philadelphia; U.M.M.Z., to the University of Michigan Museum of Zoology. Most color terms are from Ridgway (1912).

Oryzomys (Oryzomys) alfaroi intagensis, new subspecies

Holotype.—Adult male, skin with skull; U.M.M.Z., no. 77152; collected April 24, 1934, by Philip Hershkovitz; original no. M195. Paratypes, 24 males, 5 females (skins with skulls); 7 complete skeletons, U.M.M.Z., nos. 77148–51, 77153–59, 77183–84, 77198–213.

Type locality.—Hacienda Chinipamba near Peñaherrera, Intag, in the subtropical forest of the western slope of the western cordillera of the Andes, Imbabura Province, northwestern Ecuador. Altitude, about 1500 meters.

Distribution.—Northwestern Ecuador, on the western slope of the western Andes at altitudes ranging between approximately 500 and 2000 meters. *Oryzomys alfaroi intagensis* is the southernmost representative of the widely distributed, slightly differentiated *alfaroi* group. It is probable that the range of *intagensis* is contiguous to that of *palmirae*, its nearest geographic ally. Additional specimens of *intagensis* were taken at an altitude of about 900 meters at La Carolina, Río Mira Valley, some fifty kilometers north of the type locality.

Diagnosis.—Distinguished from *O. alfaroi palmirae* by darker coloration throughout.

Coloration of holotype.—(Technical color terms are those of Ridgway, 1912.) Dorsal surface from tip of nose to base of tail ochraceous-tawny heavily lined with black; hairs deep neutral gray basally, banded ochraceous-tawny subterminally, very finely tipped with black; terminal half of guard hairs entirely black, basal portion as in other hairs. Sides of body ochraceous-buff. Proximal half of limbs externally like sides. Underparts sharply defined, uniformly pallid neutral gray with very light wash of buffy on belly and chest, scrotal region more heavily washed with buff, anal region and haired portion of base of tail almost entirely buff; deep neutral gray of basal portions of hairs visible at the surface. Fore feet whitish; hind feet whitish above, dark brown below.

Ears brown, sparsely covered with fine black hairs. Tail brown on upper surface, distinctly paler on proximal fourth of underside, but becoming unicolored terminally. There is a large patch of white behind the shoulders.

Coloration of paratypes.—The principal deviations from the coloration of the holotype are those concerned with molt. The renewal of pelage progresses along the sides to the posterior parts, thence to the dorsal surface. Thus, in many specimens, the old pelage in the region of the thighs and posterior half of the dorsum, especially the rump, is contrastingly darker in color than that of the anterior parts. The extent of the bicolored part of the tail varies from the proximal one-sixth in one specimen, to the complete length of the tail in another specimen. In some specimens the hairs on the throat and midline of the chest tend to be more nearly white than those on the other parts of the ventral surface. Five of the eighteen topotypes are marked by spots and patches of white distributed irregularly over the head, back, and sides. None of the specimens from La Carolina exhibits this variegation. The coloration of the dorsal surface and sides averages darker in the La Carolina series than in the topotypes.

Measurements (in mm.).—The first measurement, of the holotype, is followed by the means and extremes of the topotype series (including holotype) with the adults of the La Carolina series; total, 18 specimens. External (taken from the freshly killed animal): head and body, 97, 99.8 (89–122); tail, 100, 110 (99–123); hind foot (*s.u.*), 23, 24.4 (23–27); ear from notch, 17, 16.8 (15–18). Skull: greatest length, 26.8, 27.5 (26.4–28.3, seven specimens); condyle to gnathion, 24, 24.5 (23.6–25.8, fourteen specimens); greatest zygomatic breadth, 13.6, 13.8 (12.7–14.6, fifteen specimens); length of nasals, 10.1, 10.9 (9.9–12, nine specimens); interorbital constriction, 4.5, 4.7 (4.0–5.2); braincase (greatest width across parietals), 11.1, 11.1 (10.8–11.6, fourteen specimens); length of palatal bridge, 5.4, 5.7 (5.1–6.1); palatine foramina, 4.3 by 2.6, 4.3 by 2.2 (4.0–4.6 by 2.1–2.6); alveolar length of upper molar row, 3.6., 3.9 (3.6–4.0); diastema, 6.8, 6.5 (5.8–7.0).

Remarks.—Probably assignable to *intagensis* are two specimens recorded as *gracilis* by Lönnberg (1913: 27) (one from Mindo and the one from Gualea); also the specimen recorded from northern Ecuador by Goldman as *gracilis* (1915: 129) and later (1918: 62) as either *gracilis* or *palmirae*. It is of interest to note that Lönnberg (1913: 27) remarked concerning his specimens that "both are pied, the former with a broad whitish patch on left shoulder, the latter [with patches] on both sides." This agrees with the variegated condition that occurs among the specimens of the type series of *intagensis*.

Specimens examined.—Oryzomys alfaroi intagensis: Peñaherrera, Ecuador, 11 (U.M.-M.Z.); La Carolina, Imbabura Province, Ecuador, 19 (U.M.M.Z.). *O. a. palmirae:* Miraflores, Colombia, type and type series, 6 (A.M.N.H.); Cauca Valley, Colombia, 4 (Salencio, Río Frio, Palmira, Las Lomitas), (A.M.N.H.). *O. a. gracilis:* Bogotá region, Colombia, 1 (A.M.N.H.).

Oryzomys (Oligoryzomys) spodiurus, new species

Holotype.—Adult male, skin with skull, U.M.M.Z., no. 77176; collected May 6, 1934, by Philip Hershkovitz; original no. M228. Paratypes, 14 males, 3 females, skins with skulls, 1 complete skeleton, U.M.M.Z. nos. 77164–75, 77177–78, 77218–20.

Type locality.—Hacienda Chinipamba near Peñaherrera, Intag, in the subtropical forest of the western slope of the western cordillera of the Andes, Imbabura Province, Ecuador. Altitude, about 1500 meters.

Distribution.—Subtropical forests of the western Andes in Ecuador. Although this species is known only from the type locality, it is highly probable that the *Oligoryzomys* recorded from many localities in western Ecuador as either *longicaudatus* or *stolzmanni*, are assignable to *spodiurus*.

Comparisons.—In size, external appearance, and skull characters *spodiurus* is most

nearly allied to the Peruvian *Oligoryzomys* which have been referred to the *longicaudatus* group. Comparisons of *spodiurus* were made with the type of *O. andinus* Osgood from western Peru, with a series of four specimens here considered as representatives of *stolzmanni* Thomas, and with another series of four specimens which undoubtedly represent *destructor* of Tschudi, (see p. 81).

Oryzomys spodiurus is distinguished from *andinus* by its narrower nasals, fully expanded palatine foramina, longer and heavier molar-tooth row, wider palate and mesopterygoid fossa, and narrower and lighter zygomatic arches and anterior zygomatic plates; the body and hind foot are smaller. In coloration, both forms are similar except that the tail is grayish in *spodiurus*, pale brown in *andinus*.

Distinguished from *stolzmanni* by longer tail, color of underparts less buffy, feet more heavily haired whitish, and tail grayish, not brown; skull larger, palatine foramina wider, incisors longer and heavier, nasals longer and narrower.

O. spodiurus appears to be most nearly related to *O. destructor*, with which it agrees in external measurements, but is slightly duskier in coloration throughout. As in the Peruvian forms, the tail of *destructor* is pale brown. The skull characters of *destructor* are essentially like those of *stolzmanni*, except for the larger dimensions, which equal those of *spodiurus*.

Coloration of holotype.—Dorsal surface, from crown to base of tail, ochraceous-tawny overlaid with black on middorsal region; individual hairs at base pale mouse gray, terminally ochraceous-tawny minutely tipped with black. Cheeks and forehead warm buff. Well-haired ears sayal brown on outer surface, paler on inner surface. Sides and thighs warm buff with grayish grizzling. A distinct ochraceous-buff lateral line present. A large white patch is present on the right shoulder—a purely individual character. Upper surface of forelegs buffy with basal gray of hairs showing through. Belly and inner surface of hind legs whitish, lightly washed with light buff, gray basal portion of hairs showing through distinctly. Undersides of forelegs, neck, chin, and area surrounding mouth nearly white; gray bases of hairs short and hardly visible at the surface. Forefeet and hindfeet whitish. Tail deep mouse gray above, mouse gray on proximal three-fourths of underside, converging terminally to color of upper surface.

Coloration of paratypes.—The face is uniformly paler than the crown and remainder of upper parts. Lateral line always present. On the ventral surface the gray of the basal parts of the hairs is always visible from the surface; the buffy wash is extremely light in some specimens, heavier in others, but never becoming the dominant color. Other external markings as in the holotype. The pelages of the young adults are darker than those of the older individuals. Three specimens, in addition to the holotype, have conspicuous white patches at the sides or in the shoulder region. In all the others there is present a sprinkling of white hairs on the sides.

Measurements (in mm.).—The first measurement, of the holotype, is followed by the means and extremes of the type series (including holotype) of 15 adults (13 males, 2 females). External (taken from the freshly-killed animal): head and body, 101, 91.3 (72–109); tail, 136, 128.4 (120–142); hind foot (*s.u.*), 24, 23.3 (22–25); ear from notch, 16, 15.5 (14–17). Skull: greatest length, 26.8, 25.6 (24.5–26.8, six specimens); condyle to front of incisor, 23, 22.4 (21.0–23.0, twelve specimens); zygomatic breadth, 13.4, 13.0 (12.1–13.7, ten specimens); length of nasals, 9.8, 9.3 (8.6–9.8, nine specimens); the interorbital constriction, 3.6, 3.4 (3.3–3.6); braincase (greatest width across parietals), 11, 10.8 (10.4–11.2, twelve specimens); palatal bridge, 4.2, 4.2 (4.0–4.7, fourteen specimens); palatal foramina, 4.9 by 2.1, 4.6 by 2.0 (4.3–4.9 by 1.7–2.1); alveolar length of upper molar row, 3.8, 3.6 (3.4–4.0); diastema, 6.3, 5.8 (5.3–6.3).

Remarks.—Some uncertainty has existed with regard to the specific name applicable to the eastern Peruvian and western Ecuadorian *Oligoryzomys*. The two described forms from western Peru, *arenalis* Thomas and *andinus* Osgood, appear to be quite distinct from each other and are not to be confused with the eastern Peruvian forms and

O. spodiurus. Thomas (1926a: 611) synonymized *stolzmanni* with *minutus* Tomes and subsequently referred all the Peruvian *Oligoryzomys*, except *arenalis*, to *minutus*. He implied (1926b: 160) that *andinus* Osgood was identical with *minutus*. Later, in reporting on a collection of mammals from Peru, (1927: 369) he concluded that *Oryzomys longicaudatus destructor* Tschudi "with which his [Tschudi's] *melanostoma* was synonymous, would seem to be the proper term for the Peruvian mouse commonly called *minutus* or *stolzmanni*." In addition, Thomas expressed his belief that "the Peruvian long-tailed mice are not specifically distinguishable from the *O. longicaudatus* of Chili, of which they may best be treated as a local sub-species." As a result, he thereafter listed all the eastern Peruvian *Oligoryzomys* under *O. longicaudatus destructor*.

Osgood (1933: 1) showed, however, that Thomas erred in regarding *minutus* (*Microryzomys*) as an *Oligoryzomys*. As for *stolzmanni* and *melanostoma*, Thomas gave no grounds for referring them to *destructor*. The inference is that Thomas adopted the latter name simply because it is the oldest. Although it is true that the described forms of the eastern Peruvian *Oligoryzomys* bear a high degree of resemblance to each other and to *spodiurus*, there are differences in characters which are here considered to be of sufficient importance to separate them. If, as stated by Thomas, *destructor* is a race of *longicaudatus*, the form *stolzmanni* must equally be considered a distinct race of the same species. The Ecuadorian *spodiurus* may likewise be shown to be referable to *longicaudatus*. However, no specimens of typical *longicaudatus* are at hand for comparison, therefore, to avoid arbitrariness, I am provisionally giving *O. spodiurus* specific rank.

Of the specimens examined, the series of *stolzmanni* represents those recorded by Osgood (1914: 154), whose conclusions regarding their identity are here accepted. Concerning the specimens of *destructor*, Osgood advises (in *epist.*) that these were taken in the vicinity of Tschudi's home in Peru. Tschudi (1844: 184) remarked that he found a pair of these mice nesting in a chest in which he had kept his natural history collection during a period of several months. According to Tschudi, *destructor* is the house mouse of the plantations which border on the virgin forests of eastern Peru. Taking this as an indication of the type locality, it is obviously within the zone which Tschudi (1844: xxviii) describes as the "*Eigentliche Waldregion*" and which includes also the localities in the Río Chinchao district where the specimens at hand were collected. Furthermore, these mice agree closely with the original description of *destructor* and with the color plate of the type (1844: 182, pl. XIV, fig. 1). These considerations make it necessary to regard the Chinchao specimens as *destructor*. It appears from Tschudi's description (1844: 182, pl. XIV, fig. 2) that *melanostoma* is a distinct form.

Specimens examined.—*Oryzomys* (*Oligoryzomys*) *spodiurus:* Peñaherrera, Ecuador, 18 (U.M.M.Z.). *O.* (*O.*) *longicaudatus destructor:* Río Chinchao, Huanuco Province, Peru, 4 (Hacienda Buena Vista, altitude, 3500 feet, 2, Hacienda San Antonio, altitude 3000 feet, 1, Hacienda Vista Allegre, altitude 3000 feet, 1), (F.M.N.H.). *O.* (*O.*) *longicaudatus stolzmanni:* Moyabamba, Peru, 2 (F.M.N.H.); Uchco, Peru, 2 (F.M.N.H.). *O.* (*O.*) *andinus:* Hacienda Llagueda, upper Río Chicama, Peru, the type (F.M.N.H.).

Microryzomys altissimus hylaeus, new subspecies

Holotype.—Adult male, skin with skull; U.M.M.Z. no. 77224; collected September 29, 1934, by Philip Hershkovitz; original no. M288. Paratype, adult female skin with skull U.M.M.Z. no. 77223.

Type locality.—Temperate rain-forest of the western slope of the eastern cordillera, at the site Atal, within the confines of the Hacienda Indújel del Vinculo, near San Gabriél, Montúfar, Carchi Province, Ecuador. Altitude, about 2900 meters.

Distribution.—Confined to the higher altitudes of that portion of the eastern Andes known as the Cordillera de Pimanpiro.

Diagnosis.—Distinguished externally from *M. a. altissimus* by smaller size, darker

upperparts, and by the color of the underparts, which is not well defined from that of the sides. The skull of *hylaeus* is smaller, and the nasals taper abruptly to pointed tips, whereas in *altissimus* the tips of the nasals are slightly expanded and rounded.

Coloration of holotype.—Hairs of the dorsal surface plumbeous basally, ochraceous-buff subterminally, minutely tipped with black; guard hairs long, conspicuous, and projecting well beyond the other hairs giving a blackish cast to the area. Sides of body like back, but with guard hairs greatly reduced in number; an ochraceous lateral line. Ventral surface not sharply defined, warm buff in color with the plumbeous basal portions of the hairs showing through prominently. Tail bicolor for entire length, slightly pencilled. Fore and hind feet whitish; white hairs at base of claws long and abundant. The orange-buff postauricular patches present in *hylaeus* are absent in *altissimus*.

Coloration of paratype.—Essentially like the holotype, but slightly darker on the dorsal surface; postauricular patches less prominent.

Measurements of holotype and paratype.—External (taken from the freshly killed animal): total length, 174, 170; tail, 104, 96; hind foot (*s.u.*), 21, 21; ear from notch 15, 16. Skull: greatest length, 22,—; condylo-incisive length, 18.9,—; zygomatic breadth, 11.3,—; braincase (greatest width across parietals), 10.4,—; interorbital constriction, 3.2, 3.0; interparietal, 7.1 by 2.5, 7.7 by 2.0; length of nasals, 7.7,—; palatine foramina, 4.1 by 1.4, 4.1 by 1.5; palatal bridge, 3.2, 3.5; diastema, 4.9, 5.2; alveolar length of upper molar row, 3.1, 3.0.

For remarks and the list of specimens examined, see below.

Microryzomys altissimus chotanus, new subspecies

Holotype.—Adult male, skin with skull, U.M.M.Z. no. 77222; collected June 20, 1934, by Philip Hershkovitz; original no. M262.

Type locality.—Southern slopes of the arid Chota Valley, parish of Pimanpiro, Imbabura Province, Ecuador. Altitude, about 2000 meters.

Distribution.—The desert and irrigated fields of the Chota Valley.

Diagnosis.—Distinguished from both *altissimus* and *hylaeus* by its paler coloration; larger, more expanded infraorbital foramina; wider palatine foramina; heavier rostrum. In size, *chotanus* agrees with *altissimus*.

Coloration of holotype.—The details of coloration in *chotanus* are very similar to those of *altissimus*; both forms lack the bright postauricular patches present in *hylaeus*. Nevertheless, *chotanus* appears to be much paler in color on the dorsal surface than either *altissimus* or *hylaeus*. This is chiefly attributable to the shortness, relative paucity, and inconspicuousness of the guard hairs which prominently line the dorsal surfaces of the other races. This is a factor directly correlated with the hot, desert environment of *chotanus* as contrasted with the cold, humid habitats of both *altissimus* and *hylaeus*.

Measurements of holotype.—External (taken from the freshly killed animal): total length, 191; tail, 115; hind foot, (*s.u.*) 21; ear from notch, 16. Skull: Condylo-incisive length, 19.7; zygomatic breadth, 11.3; braincase, (greatest width across parietal), 11; interorbital constriction, 3.4; interparietal, 8.9 by 2.7; palatine foramina, 4.2 by 1.6; diastema, 5.7; alveolar length of upper molar row, 3.2.

Remarks.—Osgood (1933: 6) pointed out that *altissimus* "is a very distinct form possibly entitled to specific rather than subspecific rank" under *minutus*, to which he assigned it. That *altissimus* is specifically distinct from *minutus* is evident both from its distribution and from its external appearance and skull. Osgood (1933: 6) remarked that "*minutus altissimus*" and *minutus aurillus* had been taken in the same general locality, but he qualified this by stating that these forms were trapped at different stations, the former on the open puna, the latter in the edge of the forest below the puna. He further remarked that in other places, in northern Peru and in Ecuador, these two

forms were found under the same conditions, i.e., the one in the open country, the other in the adjacent forests. However, my two specimens of *hylaeus* were taken in the same trap line that yielded specimens of *minutus*. This trap line was set at the edge of a small cornfield entirely surrounded by virgin forest. Thus, it is conclusively shown that both *altissimus* and *minutus* can be found in exactly the same habitat and that at least one race of the former is a forest-dweller.

The coloration of *Microryzomys altissimus* is "much paler [than *minutus*]. . ., the tail broadly and completely bicolor,. . . . Upper parts with dominant color ochraceous-buff to light buff rather than ochraceous-tawny [as in *minutus*]" (Osgood, 1933: 5). In cranial characters *altissimus* is distinguished from *minutus* by its more delicate skull; more inflated braincase; narrower nasals; more rounded supraoccipital; narrower interparietals, measured along the antero-posterior axis; longer molar-tooth row; relatively narrower molariform teeth. In *altissimus* the palatine foramina extend posteriorly beyond the level of the molars; in *minutus* these foramina terminate anterior to the level of the molars. The tubercle on the lateral surface of the mandible at the root of the incisor is strongly projecting in *minutus* and is reduced in *altissimus*.

The specimens of *Microryzomys* recorded from Ecuador by Stone (1914: 10) as "*minutus* (Tomes)," are referable to the species *altissimus* and are more closely related to the northern Ecuadorian races than to the Peruvian *altissimus*. However, they differ from all the described races of *altissimus* by their slightly darker coloration on back and sides, their brown fore and hind feet, and by their smaller skulls. Stone (1914: 10) recorded these mice from the "vicinity of Hacienda Garzón (or Rosario) at the southern foot of Mt. Pichincha (Western Andes), some of them 'in meadows and swamps below the house, 10,150 feet,' others higher up near the paramo, 12,000 feet."

Specimens examined.—Microryzomys altissimus hylaeus: Atal, Ecuador, 2 (U.M.-M.Z.). *M. a. chotanus:* Pimanpiro, Ecuador, 1 (U.M.M.Z.). *M. a. altissimus:* La Quinua, Peru, 4 (F.M.N.H.). *M. a.* subsp.: Hacienda Garzón, foot of Mt. Pichincha, Ecuador, 3 (A.N.S.P.). *M. minutus* subsp.: Atal, Ecuador, 2 (U.M.M.Z.). *M. m. aurillus:* Huanuco, Peru, 1 (F.M.N.H.); Molinopamba, Peru, 2 (F.M.N.H.). *M. m. humilior:* San Juan de Río Seco, Colombia, 1 (A.M.N.H.); Quipile, Colombia, 1 (A.M.-N.H.); Macotama, Colombia, 1 (A.M.N.H.). *M. m. fulvirostris:* Munchique, Cauca, Colombia, the type (A.M.N.H.); Gallera, Colombia, 1 (A.M.N.H.); "Western Andes, 40 miles west of Popayan," Colombia, 1 (A.M.N.H.).

LITERATURE CITED

Goldman, E. A. 1915. Five new rice rats of the genus *Oryzomys*. Proc. Biol. Soc. Wash., vol. 28, pp. 127–30.

———— 1918. The rice rats of North America. North Amer. Fauna, no. 43, pp. 1–100.

Lönnberg, E. 1913. Mammals from Ecuador and related forms. Ark. f. Zool., Stockholm, vol. 8, no. 16, pp. 1–36; 1 colored pl.

Osgood, W. H. 1914. Mammals of an expedition across northern Peru. Field Mus. Nat. Hist. Zool. Ser., vol. 10, no. 12, pp. 143–85.

———— 1933. The South American mice referred to *Microryzomys* and *Thallomyscus*. Field Mus. Nat. Hist. Zool. Ser., vol. 20, no. 319, pp. 1–8.

Ridgway, R. 1912. Color standards and color nomenclature. Washington: Published by the author.

Stone, W. 1914. On a collection of mammals from Ecuador. Proc. Acad. Nat. Sci. Philadelphia, pp. 9–19.

Thomas, O. 1926a. The Godman—Thomas Expedition to Peru.—II. On mammals collected by Mr. Hendee in north Peru between Pacasmayo and Chachapoyas. Ann. Mag. Nat. Hist., ser. 9, vol. 17, pp. 610–616.

——— 1926b. The Godman—Thomas Expedition to Peru.—III. On mammals collected by Mr. Hendee in the Chachapoyas region of north Peru. Ann. Mag. Nat. Hist., ser. 9, vol. 18, pp. 156–67.

——— 1927. The Godman—Thomas Expedition to Peru.—V. On mammals collected by Mr. Hendee in the Province of San Martin, north Peru, mostly at Yurac Yacu. Ann. Mag. Nat. Hist., ser. 9, vol. 19, pp. 361–375.

TSCHUDI, J. J. VON. 1844–1846. Untersuchungen über die fauna Peruana, Einleitung, pp. i–xxx; Therologie, pp. 1–262; color plates, I–XVIII.

Museum of Zoology, University of Michigan, Ann Arbor, Michigan.

CRITICAL NOTES ON THE TEXAS BEAVER

By William B. Davis

When Bailey (N. Amer. Fauna, 25, p. 122, 1905) described *Castor canadensis texensis* from the drainage basin of the Colorado River in Texas he had available only three specimens, the type, a considerably faded dismantled mounted specimen, and two skulls. Because of additional specimens (Nos. 870, 1028, 1053–1066, Texas Cooperative Wildlife Collection) collected on the South Llano River, tributary to the Colorado River, by Arthur H. Cook, field biologist of the Texas Cooperative Wildlife Research Unit, it seems advisable to place on record a more extended description of the Texas beaver.

Comparison of our specimens with the original description indicates that the descriptive and supposed diagnostic characters of the race were based almost entirely upon an unusually large animal. None of our specimens, even though fully adult, are as large as the type. The paratype, skull only (U. S. Nat. Mus., no. 41869), from Cypress Mill, Blanco County, Texas, approaches more nearly the mean size of our material.

The following description is based on twelve specimens, seven of which are fully adult.

Color.—(Winter) Rich reddish brown above, lighter, more nearly chestnut, on base of tail, shoulders, and cheeks; pale plumbeous brown below; upper surfaces of feet much darker, more nearly chestnut brown, than legs.

(Summer) General coloration darker; feet and base of tail deep chestnut, in striking contrast to the paler legs and body.

Skull.—Nasals relatively long, expanded to greatest width about middle of rostrum, and sharply pointed posteriorly; ratio $\frac{\text{width of nasals}}{\text{length of nasals}}$ averages 50; sagittal crest long and well developed in most specimens, but in some, even though adult, short and with lyrate temporal ridges.

Comparison.—As compared with *Castor canadensis mexicanus* Bailey from the Rio Grande in El Paso County, Texas, *texensis* differs as follows: Considerably darker, both dorsally and ventrally; feet chestnut colored, rather

than fulvous; tail relatively longer and narrower (see fig. 1); nasals expanded distally and sharply pointed posteriorly, rather than nearly parallel sided and nearly truncate posteriorly; distance from lacrimal process to postorbital process less (17 mm. as compared with 21 mm.); rostrum shorter (34 mm. as compared with 37 mm.), and relatively broader; dorsal outline of skull more flattened, rather than depressed anteriorly (see fig. 2).

Measurements.—Average and extreme measurements, in millimeters, of 5 adult females: Total length 1063 (963–1172); length of scaly portion of tail 244 (229–268); breadth of tail, 114 (102–127); length of hind foot, 164 (159–172); basilar length of Hensel, 116.0 (112–117); zygomatic breadth,

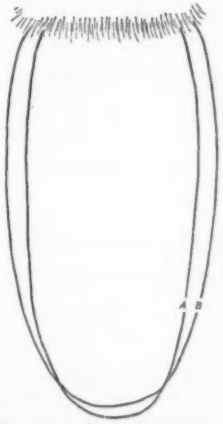


FIG. 1. Outline tracings of the tails of (A) adult female *Castor canadensis texensis* from Kimble County, Texas, and (B) adult female *C. c. mexicanus* from El Paso County, Texas. The tail in *mexicanus* is relatively shorter and broader than in *texensis*. Approximately one-fourth natural size.

95.3 (92.3–98); mastoidal breadth, 65.5 (63.6–67.4); length of nasals, 51.2 (49.3–53.6); greatest breadth of nasals, 25.7 (25.0–26.7); alveolar length of maxillary tooth row, 32.2 (29.5–33.5).

Three of these females weighed 38, 36, 27 pounds, the last being emaciated from an infestation of screw worm larvae.

Measurements of one adult and one subadult male: Total length, 1057, 910; length of scaly portion of tail, 230, 280; breadth of tail, 118, 107; length of hind foot, 166, 175; basilar length of Hensel, 119, 106; zygomatic breadth, 97.2, 89.5; mastoidal breadth, 66.3, 60.2; length of nasals, 53.2, 50.4; greatest breadth of nasals, 26.5, 25.0; alveolar length of maxillary tooth row, 30.5, 30.4.

Remarks.—Bailey (*loc. cit.*) states that the type of *texensis* is pale, "as in

frondator, possibly due *in part* [italics mine] to fading." Actually, the pale coloration must be due almost entirely to fading because *all* of our specimens are considerably darker than material from near El Paso, which is in the range formerly assigned to *frondator*, but which now is assigned to the race *mexicanus*. Bailey apparently considered the lyrate temporal ridges as diagnostic of *texensis*. Our specimens vary considerably in this respect, ranging from lyrate temporal ridges to a fully developed, long sagittal crest.

As I see them, the outstanding characters of *texensis* are: Relatively dark color; posteriorly pointed nasals, with an expanded area near middle of rostrum; distance from lacrimal to postorbital processes about 17 mm.; dorsal outline of skull nearly flat, except for the distal portion of the rostrum which is *abruptly* depressed; tail relatively long and narrow, ratio of width to length, 48 (39–55).

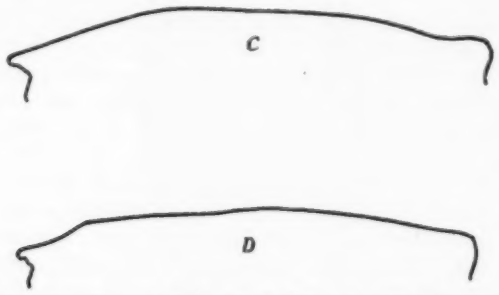


FIG. 2. Mid-dorsal outlines of skulls of adult females (C) *Castor canadensis mexicanus* from El Paso County, Texas, and (D) *C. c. texensis* from Kimble County, Texas. Note the abrupt depression at the anterior end of the rostrum in *texensis*. About one-half natural size.

I am aware of the fact that because our specimens differ considerably from Bailey's description they might possibly be considered as distinct from *texensis*. But the fact that they are from the same hydrographic basin whence came the type and the two paratypes used by Bailey is a strong argument against such a conclusion. I am of the opinion that our specimens should be referred to *texensis* without reservations.

Specimens examined.—Twelve from Texas, as follows: *Blanco County:* Cypress Mill, 1, paratype (Biol. Surv. coll.). *Kimble County:* South Llano River, from Junction south to the Edwards County line, 6; 8 mi. S. Segovia, 1. *Edwards County:* South Llano River, 4.

I wish to acknowledge the cooperation of Dr. H. H. T. Jackson by making it possible for me to examine pertinent material in the Biological Survey collections.

Texas Cooperative Wildlife Research Unit, College Station, Texas.

A NEW RACE OF BEAVER FROM OREGON

By Stanley G. Jewett and E. Raymond Hall

In 1914 William L. Finley and the senior author had saved for the collection of the Oregon Game Department three beavers from the drainage of the Nehalem River, one of the streams on the Pacific coastal slope west of the watershed of the Willamette River. At the time of preparation these were recognized as exceptionally dark-colored, small beaver. With the aim of classifying these specimens, an invoice was taken, about a year ago, of material in the Museum of Vertebrate Zoology, which showed that but relatively little additional material was needed to allow of identifying the specimens from Nehalem. This additional material, through the cooperation of Mr. Frank B. Wire and his associates in the Oregon Game and Fish Commission, was saved from animals accidentally killed in live-trapping and transplanting of beavers. Comparisons at the Museum of Vertebrate Zoology of the assembled material confirm the original suspicion that the coastal animals belong to an heretofore unnamed geographic race. This may be known and described as follows:

Castor canadensis idoneus, new subspecies

Type.—Adult, skull-alone, of unknown sex; no. 86941, Mus. Vert. Zool.; Foley Creek, tributary to Nehalem River, Tillamook County, Oregon; December 15, 1914; trapped by Edward Leach; original no. 548 of S. G. Jewett, preparator.

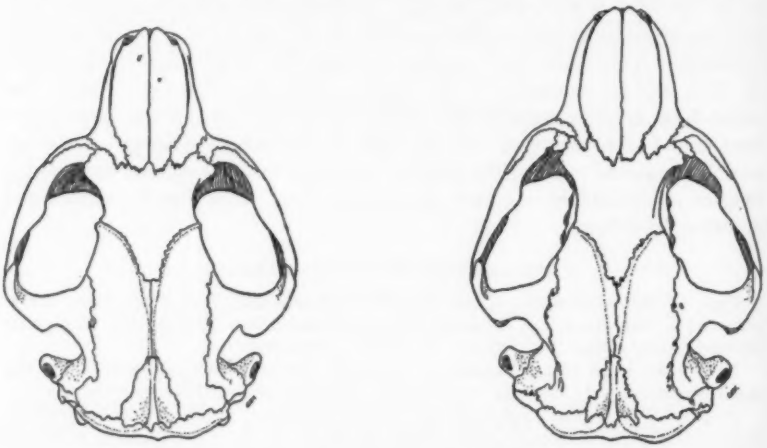
Range.—Probably humid coastal area in Oregon west of the Willamette drainage, but definitely known only from the type locality and from Blaine, Tillamook County.

Diagnosis.—Size small; color nearer black than mummy brown of Ridgway (Color Standards and Color Nomenclature, Washington, D. C., 1912); skull small, relatively broad, with nasals not extended much, if any, behind premaxillae.

Comparison.—*Castor canadensis pacificus* (known to us by specimens saved by Victor B. Scheffer from Swauk River, Kittitas County, Washington, and from the figures and descriptions by Rhoads, Trans. Amer. Philos. Soc., N.S., **19:** 417–423, pls. 21, 22, 1898, and by Benson, Jour. Mammalogy, **14:** 320–325, fig. 1, 1933) is the geographically adjoining subspecies, and the two have many cranial features in common. For example, the abrupt indentation posteriorly in the lateral outline of each nasal, the similar shape of the hamular process of the pterygoid, and many other details of the skull are alike. Cranial differences which set *C. c. idoneus* apart are: Size less; zygomatic arches more expanded anteriorly; interorbital breadth relatively more, amounting to more, rather than less, than distance between parietal and maxillary bones on dorsal face of skull; nasals not twice as long as broad (width averages 54 percent in *idoneus* and 44 percent in *pacificus*), not extended much if any, rather than far, behind premaxillae, and with lateral margins more convex.

Remarks.—A specimen from Pudding River, Clakamas County, Oregon, has the size of skull and construction of the nasals as in *pacificus*, to which it is here referred, but the zygomatic arches anteriorly are more expanded as in *idoneus*. The skulls used by us in comparison have the suture between the basioccipital and basisphenoid bones closed or nearly so. The color of the two adults of *idoneus*, as the senior author remembers it, is extremely dark. This would be expected by analogy with the dark coloration of other

vertebrates which live in the coastal belt. There is evidence (see Bailey, North Amer. Fauna, no. 55, p. 219, 1936) that beavers lived in most of the streams along the coast of Oregon and Washington, but how far north or south the race *idoneus* originally occurred probably never will be fully ascertained because the colony on the Nehalem River from which our specimens came is one of the very few bordering the coast not trapped out. Of the three skins originally saved only that of the one juvenile can now be located. The skin of this specimen, S. G. Jewett field no. 549, which measured, total length, 775; length of tail, 250; length of hind foot, 150, has the general color darker than in any other specimen of North American beaver at hand. It is darker (less reddish and more blackish) even than *Castor c. phaeus*, of which specimens of comparable age, as well as specimens younger and older, are available. This is true of the guard hairs and



A *B*

FIG. 1. Dorsal views of skulls of two subspecies of beavers. × ⅓. *A. Castor canadensis idoneus*, type specimen. *B. Castor canadensis pacificus*, M.V.Z. no. 86943, from Swauk River, Kittitas County, Washington.

of the distal half of the underfur. The basal half of the underfur is lighter than in *phaeus*, a difference that can be detected only when the underfur is parted to the roots.

Since writing the above, a skull, no. 387 of Alex Walker, taken November 8, 1923, from the Nestucca River, at Blaine, Tillamook County, Oregon, has been examined. It is larger than the skulls from the type locality (occipitonasal length about 138.0) but agrees with them in that the nasals do not project as far posteriorly as do the premaxillae. Also, on January 5, 1940, at Portland, Oregon, Mr. Frank B. Wire accorded one of us (Hall) the privilege of examining between 1300 and 1400 skins of Oregon-taken beaver that day being offered for sale. One was as dark as our young skin. This dark skin was from the vicinity of Clatskanie, Columbia County, near the mouth of the Columbia River. All the other pelts were from places much farther from the coast and all were much lighter colored. Lighter colored animals, of subspecies other than *C. c. idoneus*, have been transplanted, within the last two years, into the former range of *idoneus*. A fur buyer inspecting the skins on January 5 said that the darkest beavers

from Oregon came from the mouth of the Columbia River and coastal streams to the south.

Measurements.—Cranial measurements of the two adults of *C. c. idoneus*, nos. 548 and 550 of S. G. J., with measurements in parentheses of two *C. c. pacificus* of corresponding age (M.V.Z. nos. 86942, 86943) from Swauk River, Kittitas County, Washington, are as follows: Occipitonasal length, 127.0, 121.0 (141.8, 135.3); condylobasal length, 131.2, 122.4 (135.6, 131.6); basilar length, 114.2, 107.0 (119.3, 117.6); zygomatic breadth, 94.7, 90.2 (100.8, 95.5); mastoidal breadth, 60.8, 60.6 (67.0, 67.1); interorbital constriction, 27.0, 24.3 (23.5, 25.1); length of nasals, 46.3, 41.5 (52.4, 48.7); width of nasals, 24.1,23.2 (22.9, 24.9); maxillary toothrow, 30.6, 28.4 (31.4, 31.9). External measurements of nos. 548 and 550, taken by the senior author from the animals in the flesh, were, respectively: Total length, 960, 1101; length of tail, 285, 305; length of hind foot, 170, 185.

Specimens examined.—Four: Three from the type locality and one from Blaine, Tillamook County, Oregon.

1404 Bidwell Street, S. E., Portland, Oregon, and California Museum of Vertebrate Zoology, Berkeley, California.

GENERAL NOTES

SOREX LONGIROSTRIS NEAR THE TYPE LOCALITY

On December 31, 1937, my daughter, Wilhelmina B. Coleman, and I trapped a specimen of the rare and elusive *Sorex longirostris* near Goose Creek Church, about 16 miles north of Charleston, S. C. The place of capture is approximately 48 miles in a straight line from the type locality, Cat Island, at the mouth of the Santee River. It was caught in moist, mixed woods with a heavy ground cover of fallen leaves and prostrate honeysuckle vines. A small piece of shelled pecan was used as bait. The animal is a female, number 1062 in my collection. Its measurements taken in the flesh are: total length, 83 mm.; tail vertebrae, 33.5; hind foot, 10.5. It weighed 3 grams.

Bachman described this species in 1837 (Jour. Acad. Nat. Sci. Philadelphia, vol. 7, pt. 2, p. 370), basing his account on a specimen found by laborers while digging a ditch "in the swamps of Santee." He had also seen another individual, taken from the gullet of a hooded merganser killed in the Colleton district. The next record of the animal's capture in South Carolina was not made until 1933, when A. L. Nelson wrote (Jour. Mamm., vol. 15, no. 3, p. 254, August 11, 1934): "In a lot of 6 [barn owl] pellets taken on the Combahee plantation in Colleton County [by E. B. Chamberlain of the Charleston Museum], on March 25, 1933, the fragments of this rare and locally distributed shrew were retrieved." The specimen referred to in the present note therefore makes the fourth record of this species in South Carolina. It is the first complete specimen to be taken here in almost exactly one hundred years. I am indebted to Dr. H. H. T. Jackson, of the Biological Survey, for confirming the identification of this specimen.—ROBERT H. COLEMAN, *Route 4, Box 212, Charleston, S. C.*

ALBINISM IN BLARINA

Recently, W. J. Hamilton, Jr. of Cornell University, in this Journal (vol. 20, No. 2, page 252) recorded several albino blarinas from New York State. To these records I would like to add one from Pennsylvania. An entirely white adult female specimen of *Blarina brevicauda talpoides* with pink eyes was collected on May 15, 1936 on the State Game Refuge near Brockway, Jefferson County, Pennsylvania by Earl E. Smith and is

now no. 18007 in the mammal collection of the Academy of Natural Sciences in Philadelphia.

The only other short-tailed shrew in the Academy's collection tending toward albinism is an adult female caught by a cat and collected by Lucy Lee Harper in Swarthmore, Delaware County, Penn., on July 25, 1939. The white area covers most of the abdomen, extending in a narrow arm toward the left fore-leg. From the abdomen it extends over the animal's hips and includes both hind legs. The tail is tipped with white hairs.—FREDERICK A. ULMER, JR., *Academy of Natural Sciences, Philadelphia, Pa.*

DASYPTERUS FLORIDANUS IN SOUTH CAROLINA

Late in the afternoon of July 20, 1939, I shot an adult female *Dasypterus floridanus* (number 1159 in my collection) as it flew over the lawn to the south of my home, five miles northwest of Charleston, S. C. The afternoon had been heavily overcast and darkness came on much earlier than usual. As twilight deepened a slight sprinkle of rain began to fall. *Nycticeius humeralis* was abroad early and flying at a low altitude. While there was still just enough light to see indistinctly, the *Dasypterus* flew over at an altitude of about 30 feet. Its large size was conspicuous. A lucky shot brought it down; and, after considerable search, I found the specimen lodged in the fork of a large shrub. The specimen was sent to the Biological Survey for examination. Dr. H. H. T. Jackson, of the Biological Survey, writes me that this specimen appears to furnish the first record from South Carolina; also, that the Survey has no record for Georgia.

Since July 20 I have been constantly looking for other specimens of this bat. On three occasions I am convinced I have seen a single individual fly over my place at a considerable altitude. This individual always follows the same course, flying directly from north to south, considerably out of range of my 410 repeater.—ROBERT H. COLEMAN, *Route 4, Box 212, Charleston, S. C.*

POLAR BEARS IN THE GULF OF ST. LAWRENCE

In the Journal of Mammalogy for May 14, 1939, Dr. H. H. T. Jackson recorded the killing of a polar bear at Lake St. John, Quebec. As the occurrence of a polar bear in such a habitat seemed unusual, the note aroused considerable interest on my part. During two expeditions to Hudson Bay in 1935 and 1938 I had opportunity to make observations on polar bears in that region. They are common as far south as the Twin Islands in James Bay and are found in some abundance on several of the other islands that lie well offshore. However, they are rarely found along the mainland, and while it is true that they have been reported from as far south as Moose Factory, their occurrence there is rare. The polar bear's typical habitat is the barren, windswept arctic zone, of which the Twin Islands (see M. T. Doutt, Carnegie Magazine, December 1935) are the southernmost outposts in the James Bay region.

In view of these facts, it seems to me almost incredible that a polar bear should wander through wooded country for nearly 400 miles south of its normal range. During the past summer I traveled, in company with W. E. Clyde Todd and Mrs. Doutt, to the Grand Falls of the Hamilton River, Labrador. Our route took us down the Gulf of St. Lawrence from Montreal to the Straits of Belle Isle and northward along the Labrador Coast to Hamilton Inlet. The steamer stopped to unload freight at most of the ports along the north shore, and from Blanc Sablon to Battle Harbor we traveled in a motorboat; so we had an opportunity to inquire about the presence of polar bears at many places along the north shore.

I was impressed with the fact that polar bears had been seen at a great many of the settlements along the coast. The stories all seemed to have one thing in common—when the bear comes ashore it immediately starts north across the land. In only one

instance, at Thunder River, did we hear of the bear's going *south*. Mr. George L. Harrison whom I met on board the S. S. Sable I. told me that a polar bear had been seen at Thunder River a year or two previously. [See note in Jour. Mamm., vol. 20, p. 503.] On my return trip in September John Maloney of Mingan told me that four or five years ago a Mr. Duguay of Thunder River had seen a polar bear wandering south along a wood road. When the men chased it it ran into the Gulf and swam away. A day or two later I met Mr. Cyril Morris of the Quebec Department of Fisheries. He corroborated the story of the polar bear at Thunder River, but was not able to give me the details at that time. Since then, however, I have received a letter from him, dated at Quebec, November 22, 1939, in which he replies to my questions as follows:

> "The bear was first seen at Thunder River by Joseph Duguay, April 21, 1927. It was headed south. It was killed by Francois Boudreault at West Point of Anticosti Island one day later. The skin measured nine feet. This was the only bear ever seen so far westward along the North Shore."

All three of these stories undoubtedly refer to the same animal, and thus they make both the southernmost and westernmost records of polar bears in the Gulf of St. Lawrence.

Reverend J. H. Dicker, Anglican minister, who for several years has been stationed at Harrington Harbor, told me that a polar bear was killed about the middle or end of May 1939 on Grosse Island, sometimes called Mecatina Island, which lies about eight miles east of Cape Mecatina.

At Red Bay Mr. W. Y. Pike told me that at East St. Modest (about 20 miles west of Red Bay), Bill Dorey had shot at a polar bear on June 22, 1939. His shots only wounded it, however, and it swam out into the Bay again. Mr. Pike said that polar bear tracks are seen every year in the vicinity of Red Bay.

Of course the Gulf of St. Lawrence is not densely populated and a polar bear could easily pass unnoticed along the coast with the ice. Undoubtedly many bears enter and leave the gulf without being seen by man. At first thought it may seem strange that polar bears should be found commonly along the Gulf of St. Lawrence; but a consideration of the distributional factors involved afford a reasonable explanation. It is well known that the cold Labrador Current which moves southward along the coast of Labrador carries with it many icebergs, and is an important factor in chilling the adjacent land. The movement of this current and its effect on the plant and animal life in the Gulf of St. Lawrence is not so widely known, however. Dr. H. W. Jones, of the Canadian Tidal and Current Survey division, has very kindly supplied me with information that helps a great deal in the understanding of this problem.

The Labrador Current splits as it passes the Straits of Belle Isle, most of it going south along the east coast of Newfoundland; but a small portion also enters the Straits of Belle Isle and passes westward along the north shore of the Gulf of St. Lawrence as far as Point de Montes. In spite of the fluctuation of the tide, this current moves more to the westward than to the eastward, especially during the spring months, so that icebergs that enter the Straits of Belle Isle may continue westward along the north shore. This cold current chills the adjacent land and produces arctic-like conditions in the climate and vegetation. This arctic-like condition of the vegetation is first evident in a narrow strip along the coast slightly east of Natashquan. Farther eastward it becomes more and more pronounced.

Polar bears are notoriously aquatic in their habits and apparently think nothing of a 15 or 20 mile swim in the sea. One of their principle items of food is seal, and in pursuit of these animals they may travel over the ice many miles from land. Following the seals, which are abundant along the Labrador coast and the north shore of the Gulf of St. Lawrence, they sometimes drift southward with the ice as far as Newfoundland.

Sometimes they enter the Straits of Belle Isle and with the icebergs follow the tidal currents along the north shore.

Although Thunder River is the westernmost point in the Gulf from which I have any record of polar bears, it would seem possible that icebergs, and perhaps polar bears, might follow the favorable current as far as Point des Montes. At this point, however, the current which has been moving along the north shore swings to the south, and then to the east, along the Gaspé Peninsula. Information from Dr. H. W. Jones communicated in a letter dated October 11, 1939, seems to add further weight to the probability that polar bears might follow up along the Gulf. He states that the water in the northern part of the Gulf probably never gets warm enough to cause discomfort to polar bears. There is a perpetual cold layer beneath the surface which extends as far as deep water, i.e., to near the mouth of the Saguenay River. It is there brought to the surface by the action of the strong tidal currents meeting the shoals.

It is about 150 miles from Point des Montes to the mouth of the Saguenay River, and another 100 miles up the river to Lake St. John. This may seem to be a long distance for a polar bear to travel along a wooded coastline. Yet in view of the facts here presented, it seems to me more reasonable to assume that the bear killed at Lake St. John was working its way northward from the Gulf rather than southward from James Bay.

In any event, the presence of a polar bear at Lake St. John is a very interesting fact that calls for a summary of all the known records in this vicinity. If there are any other records of the southward extension of the bear's range I hope they will be published in the Journal of Mammalogy.—J. Kenneth Doutt, *Carnegie Museum, Pittsburgh, Pa.*

TEXAS ROCK SQUIRRELS CATCH AND EAT YOUNG WILD TURKEYS

On June 18, 1939, at 6:15 a.m., on the J. O. Tanner Ranch, 22 miles south of Junction, in Edwards County, Texas, we saw rock squirrels (*Citellus grammurus buckleyi*) catch and eat two week-old young wild turkeys (*Meleagris gallopavo intermedia*).

The young turkeys were on a rock ledge about 75 feet above us; the adult female was about 25 feet above the young. When she called, the young ran about, peeping loudly. Their distress calls attracted the squirrels which ran down the cliff, caught them, mounted a rock and ate them.

Turkeys seem to be an unusual food for rock squirrels, but according to Mr. Tanner, the squirrels frequently catch and eat his young domestic fowls.—Arthur H. Cook and W. Herman Henry, *Texas Cooperative Wildlife Research Unit, College Station, Texas.*

CHIPMUNK EATING A RED-BELLIED SNAKE

On August 23, 1939, while walking on the grounds of the Allegany School of Natural History, Allegany State Park, New York, I saw a chipmunk (*Tamias striatus lysteri*) running along a path with what appeared to be a snake in its mouth. I followed, saw it jump up on a rock and sit with its back toward me. Approaching cautiously, I circled around and came up to within 15 feet of the animal. I then could see that it held in its paws a red-bellied snake (*Storeria occipitomaculata*), alive but only feebly wriggling. As I watched, the chipmunk proceeded to eat its prey tail first, the snake continuing to wriggle feebly from side to side. When about half had been consumed the chipmunk turned the snake about and began again at the head. The whole process was a continuous one with very few pauses. It took a little over 27 minutes for the rodent to consume its prey, which appeared to be about 8 inches in length. After the chipmunk had finished its rather heavy meal, I went up to the stone upon which it had sat. Only a very small piece of snake meat and a shred of skin remained.—Samuel C. Harriot, *National Association of Audubon Societies, New York, N. Y.*

SCREWWORMS INFEST BEAVER IN TEXAS

The larvae of the screwworm fly (*Cochliomyia americana*) were found in three of the 40 beaver (*Castor canadensis texensis*) that were trapped during the summer of 1939 on the South Llano River, Kimble County, Texas.

Screwworm infestations were found only where there was apparently a high concentration of beaver. This crowding may have stimulated fighting; and the resultant wounds on the sides, back, and hind legs of the beaver would have been suitable places for the flies to deposit their eggs. Three of the trapped beaver had been thus wounded and infested. One of them died during the first night in captivity; another was found dead in the trap. The third was treated with "bone oil," a fly repellent. It recovered.

The beaver that died in captivity was an adult female, weighing only 29 pounds. Had she been well fleshed she would have weighed between 35 and 40 pounds. Unable to control the movements of her hind legs she fell from side to side as she tried to walk. During the time she was under observation, she ate little of the fresh willow that was provided.

It is common knowledge that deer frequently drown the larvae of the screwworm fly by remaining in the water for long periods. Why beaver do not do this is difficult to understand, as the fur around the wound is matted down by the discharge from within thus leaving an open sore into which water could enter when the beavers are swimming. Therefore, it seems probable that the beaver do not submerge the infected parts long enough to kill the larvae.—ARTHUR H. COOK, *Texas Cooperative Wildlife Research Unit, College Station, Texas.*

A BEAVER'S FOOD REQUIREMENTS

In the summer of 1924 three beavers, two adults and a young one, took up their residence in an artificial lake at Green Mountain Falls, a summer resort town fifteen miles up the Ute Pass from Colorado Springs, at an elevation of about 7500 feet. The first comers built a house beside an island in the lake; later the number increased to nine.

The townspeople regarded the beavers as an asset to their community, and kept them supplied with food—green boughs of aspen and cottonwood. The animals lived there during 1925 and 1926; but in the autumn of 1927 only one beaver remained, and I think it left soon after. We visited the place in July, 1926, and found that the lodge had been enlarged. The beavers had a trail on the pond bank through the tall weeds and grass, crossing a road and a railroad track and down to a creek, where they had cut some willows. A contract was given to supply the food, and the contractor was requested by the Forest Service to keep track of the amount supplied. It was found that during twelve months approximately a ton of green aspens was required for each beaver.—EDWARD R. WARREN, *1511 Wood Avenue, Colorado Springs, Colorado.*

STRANGE ACTION OF A HOUSE MOUSE

Several years ago I placed a nearly grown house mouse, *Mus musculus* Linn., in a tall glass cylinder until he might be transferred to a larger cage for observation. The captive soon passed three feces and, on turning around in his narrow quarters, two of them stuck to his tail. These he picked off gingerly with his lips, not his teeth, and, reaching as high as he could by resting his paws on the wall of his cage, stuck both against the glass. Then he picked up the dropping still remaining on the floor and added it to the two on the wall. When one of these fell from its position the mouse immediately replaced it and, soon after, added two more which he had passed in the meantime. When one of the five droppings now on the wall fell from its position he stuck it up again.

This behavior seemed to be an act of sanitation, because the mouse appeared prompted to act when he felt the feces clinging to its tail and fur. His action in putting

those up high which had not yet become stuck to his body indicates good perception, and some familiarity with similar situations; but the chain of experience from an ordinary mouse abode to a glass cage must have been put to a strong test.—CARL O. MOHR, *Illinois Natural History Survey, Urbana, Illinois.*

FIG. 1.—Strange action of a house mouse

THE STATUS OF THE GENUS ASCHIZOMYS MILLER

In October, 1898 (Proc. Acad. Nat. Sci. Philadelphia, p. 369) I described a small microtine rodent as a new genus and species, "*Aschizomys lemminus.*" My account was based on a specimen collected at Plover Bay, Chukotski Peninsula, Eastern Siberia, by C. W. Baxter, a member of the Inter-Continental Pacific Telegraph Exploring Expedition, probably during the year 1866. The one specimen in the U. S. National Museum had been recently skinned, after more than thirty years of preservation in alcohol. Nothing closely resembling it has come to my notice since then.

After a reexamination of the type (no. $\frac{9,9,1,1}{37299}$, U. S. National Museum) I am now convinced, in essential agreement with Hinton (Monogr. Voles and Lemmings, p. 43, June 26, 1926) that the animal is nothing more than an alcohol-discolored specimen of the extreme East Asian representative of *Clethrionomys rufocanus* (Sundevall). It differs from the typical Scandinavian *rufocanus* in an unusually heavy growth of bristly hairs on its tail, and in the slightly smaller size of its cheekteeth. Whether or not it has any peculiarities of color cannot now be determined. In its present condition the skin looks very different from an ordinary *Clethrionomys rufocanus* because the color lacks all trace of red; but this lack may easily be the result of more than thirty year's immersion in alcohol. The elongated bristly hairs with which the tail is clothed give the specimen a peculiar lemming-like appearance as compared with Scandinavian skins of *C. rufocanus;* but a nearly similar hair growth can be seen on the tails of several specimens of *Clethrionomys jochelsoni* (Allen) from the Kolyma River region, Siberia, collected by Copley Amory in 1914. It is, therefore, certainly not a generic character.

Whether or not this animal is identical with the one to which Lataste applied the name [*Arvicola rufocanus*] variété *kamtschaticus* (Ann. Mus. Civ. Stor. Nat., Genova, vol. 20, p. 284, March, 1884) is a question that cannot be answered until good specimens from both Kamtchatka and the Plover Bay region become available for comparison. It is now clear, however, that the *Clethrionomys rufocanus* group, if treated as distinct from true *Clethrionomys*, must be called *Aschizomys* Miller 1898 instead of *Craseomys*

Miller 1900 (Proc. Washington Acad. Sci., vol. 2, p. 87, July 26, 1890, type *Hypudaeus rufocanus* Sundevall).

In 1927 Vinogradov published a paper entitled "Notes on some mammals from Yakutia, 1. Lemming-Voles (genus Aschizomys)," Matériaux Commission Étude Rep. Auton., Soc. Sov. Iakoute, Leningrad, livr. 17, pp. 1–18, pls. 1–3. He came to the conclusion that *Aschizomys* is a valid genus. In so doing he was misled, I think, as I had previously been, by the unusually long persistence of the tooth pulps in members of the *Clethrionomys rufocanus* group as compared with the earlier formation of the roots in *C. glareolus* and its allies.—GERRIT S. MILLER, JR., *U. S. National Museum, Washington, D. C.*

NAPAEOZAPUS INSIGNIS ROANENSIS IN SOUTH CAROLINA

On July 2, 1939, near Caesar's Head, in Greenville County, S. C., at an altitude of approximately 3000 feet, my wife and I captured two individuals of the southern *Napaeozapus*. One is an adult female, number 1139 in my collection; the other is an immature female, number 1129 in my collection. Both were trapped in a narrow ribbon of shrubs and weeds lying between an old mountain road and a cold, rapidly flowing stream. The point of capture is hardly more than a mile from the North Carolina state line. Mr. A. H. Howell, of the Biological Survey, has very kindly examined both specimens and confirmed my identification. So far as I have been able to ascertain, this is the first record of this species for the State.—ROBERT H. COLEMAN, *Route 4, Box 212, Charleston, S. C.*

NOTE ON THE COTTON-TAIL RABBIT

On June 22, 1939, near Russelville, Kentucky, at different points several miles apart on a crushed limestone road, two cottontail rabbits (*Sylvilagus floridanus*) were observed, apparently rooting into or chewing the ground. When the sites where these rooting actions took place were examined, small limestone pebbles were found in a damp condition as if they had been held in the rabbits' mouths. Both animals at a distance of about fifteen yards appeared rather emaciated. It may have been that some mineral deficiency in the animals' diet was the cause of this unusual behavior.—FORREST V. DURAND, *Springfield, Tennessee.*

EASTERN ELK ANTLERS FROM PENNSYLVANIA

Mr. Louis P. Church recently presented to the American Museum of Natural History a pair of eastern elk antlers. The only available history of this specimen is that it was given to his father by a friend between 70 and 80 years ago and was said to have come from Pennsylvania.

These antlers are of a large bull elk with six points on the right side and seven on the left. They are mounted on an oak plaque with a section of the skull supporting the antlers.

Measurements are of sufficient importance to put on record as they show that the eastern elk was a race of larger animals than previously supposed. Length of outside curve: right, 1240 mm., left, 1250; greatest spread, 1280; circumference at burr, 275, 270; circumference midway between bez and trez, 168, 168; circumference of pedicel, 167. Width of skull across bases of pedicels, 118.

While I personally believe this specimen to be an eastern elk, there are no distinguishing characters whereby it can definitely be recognized as such. The antlers are more or less of average length, with rather long points but not noticeably light and slender as indicated by Bailey in his description of the specimen from Potter Co., in the Academy of Natural Sciences of Philadelphia.—G. G. GOODWIN, *American Museum of Natural History, New York City.*

THE MOOSE IN COLORADO

In "The Memoirs of Estes Park" by Milton Estes, an undated penciled manuscript written in the early part of the present century, and published in 1939 as Library Bulletin 6 of the Colorado State College Library at Fort Collins, Colorado, there is an account of the occurrence of a moose (*Alces americana*) in Colorado. As this is the only reference I have seen regarding this species in the state, it may be well to quote from the manuscript of this Colorado pioneer who was one of those who discovered, and first lived in, the area now occupied by the Rocky Mountain National Park.

In his account of the game in the area, between the years 1860 and 1866, Milton Estes wrote that during one fall and winter he killed "one hundred head of elk besides other game, such as mountain sheep, deer and antelope." In a later paragraph, he added,

"One day while out on a hunting trip, the writer came upon a band of elk and with them was a large moose. He had come down over the range from the north country and was herding with the elk. Since elk were common I picked out Mr. Moose for my game. He was a fine, large animal and the first and only moose that had ever been killed so far south."

The tales recording of the killing of "the first and only moose that had ever been killed so far south" seem definitely to add this fine animal to the Colorado state list.—ALFRED M. BAILEY, *The Colorado Museum of Natural History, Denver, Colorado.*

REVIEWS

NORTH AMERICAN BIG GAME. A book of the Boone and Crockett Club. Compiled by the Committee on Records of North American Big Game. New York, Charles Scribner's Sons, pp. xxii + 533, illus. September, 1939. Cloth, $7.50.

North American Big Game is a book of great value to the big-game hunter, conservationist, and student of wildlife. Its 24 chapters, written by 35 authors, comprise: Big game of the Pleistocene; Vanished game; Conservation of big game; Horns and antlers; Rating of trophies; Rifles and ammunition; Hunting with the bow and arrow; Photographing big game; Flashlight photography; Care of trophies in the field; Care of mounted trophies; and chapters on 13 species of big game. Following these are tabulated skull measurements of deer, sheep, goats, pronghorns, musk oxen, bison, bears, pumas, jaguars, and walruses.

The compilation herein contained of head records for the United States is most useful information, not only to the trophy hunter, but to the systematist as well. The methods described for the hunting of big game are not lacking in essential details. This is a book that may well be included in any library on natural history. However, because of the growing interest in wildlife problems, particularly on the part of those youngsters who will be the future conservationists of North America, and because such young men are ever eager for new publications devoted to wildlife, such a book ought to be particularly accurate in its presentation of facts.

Mr. Shoemaker's chapter on Vanished Game shows decided laxness in determining certain facts. It is indeed difficult to comprehend how some of the graver errors that it contains could have escaped the editors.

To the conservationist it is a matter of extreme regret that some species of North American big game have been exterminated, and others nearly so. It is, however, a moot question whether the extermination of certain of the larger species, such as the buffalo, could have been prevented, since with the settlement of the North American continent the interests of such animals were opposed to those of the settlers. From

the first settlement of the New World the records are exceedingly clear in showing the inevitable clash between man and most of our larger North American mammals. It was this competition between men and animals that constituted one of the chief factors in the almost total extermination of some of our North American big game.

It seems probable, however, that Mr. Shoemaker is painting a too pessimistic picture of some of our supposedly vanishing species, and it is obvious that his statements about others are far from indicating the conditions actually existing today. The jaguar has never been known to breed in Texas, but when found there it is a wanderer from Mexico. This is also true of the animal when found in Arizona, New Mexico, and, in more remote times, in southern California.

With reference to the "panther" in Texas, Mr. Shoemaker says that "a few remain, though stockmen and state and county rewards will have them in the list of vanished game within another five or six years." For the past 24 years, no concerted action has been taken by Federal, State, or county officials against this animal except where it was in conflict with livestock production. A total of 317 mountain lions have been killed during the past 24 years, and of these, 139 were taken during the past decade in Webb County alone, on the Mexican border, where they conflicted with cattle raising in that region. Many of the mountain lions in southern Texas undoubtedly come into the State from Mexico, where they are very numerous. That country will continue indefinitely to be a reservoir from which mountain lions will invade Texas.

The Texas red wolf is far from being an extinct species, although Shoemaker states that it "disappeared some years earlier" (prior to 1915). As a matter of fact, Texas red wolves are still found in abundance in east Texas. More than 800 were caught during the past year in the east Texas cattle country where they were in conflict with livestock production. Between 1915 and 1939 about 12,600 red wolves were taken by State and Federal field men in Texas. The habitat of this species, particularly in the east Texas thickets, is of such a nature that the animal will continue to maintain itself there for many years to come; and it is questionable whether it will ever reach the reduced status of the buffalo.

Mr. Shoemaker places the blame for the disappearance of the wolf in North Dakota upon Government poisoning drives against predators carried on as early as 1913. No Federal operations of that nature were conducted in North Dakota until several years after that date. The records also show that but one wolf was taken in North Dakota by Federal agents between the years 1915 and 1939, and they show also that the gray wolf had been practically exterminated in that State prior to these dates by the concerted efforts of farmers and stockmen. In regard to the poisoning of wolves in the Ozarks of Missouri by the Federal Government, control operations there have been conspicuous by the non-use of this method. A total of 419 wolves have been trapped in Missouri, however, during the past 23 years. A recent manuscript of S. C. Dellinger and J. D. Black of the University of Arkansas Museum states, under date of November 10, 1939, that "The wolf is becoming rather common in the Ozarks." Furthermore, it would be interesting to learn from what source Mr. Shoemaker gets his information that "Poisoners . . . are fast wiping out what are left of the fine wolves of northern Michigan peninsula," when the authorities of that State have strictly forbidden the use of poison in wolf control.

In speaking of the species of deer on the Kaibab Forest in northern Arizona, surely Mr. Shoemaker does not mean "white-tailed" deer. These are not white-tailed deer, but mule deer. No white-tailed deer have ever been found in that part of the State. The white-tailed deer in Arizona are limited chiefly to the southeastern part of the State, where they range from the southern border to the Mogollon Rim and the White Mountains. With regard to the removal of mountain lions from the Kaibab area as a factor in the critical condition now resulting from the too great increase in numbers of the

deer, I have no hesitation in saying that this is not wholly true. The fact is that the Kaibab Plateau, bounded on the south by practically impassable canyons, and on the north by unsuitable semi-desert terrain, never possessed the prime requisites of a suitable refuge. And this fact, plus the lack of proper management after the discontinuance of the previously age-long hunting by Indians and white men, were two of the chief causes of the abnormal deer increase that brought nation-wide attention in 1924, after deer had been over-protected on the area for 18 years.

The statement that the giant condor of California has been a victim of poisoned baits put out for coyote control has to date never been proved, even after at least two exhaustive field investigations on the part of Federal and California agencies. These studies did reveal, however, some traffic in the eggs of the condor, in one instance the eggs being quoted at $50 each. State and Federal conservation agents have been alert to break up this illegal practice. The decrease in the population of the condor to its present small numbers may be attributed chiefly to the reduction in the birds' food supply. Records show that its food normally consists to a large extent of the carcasses of antelopes, deer, and other wild animals that die from natural causes or are victims of predators.

In the last 12 years, only two professional wolf hunters have been sent to Alaska as an aid to the owners of reindeer herds endangered by the onslaughts of wolves. The measures for wolf control in effect are of such a minimum extent as to assure that the wolf will long form an interesting part of the fauna of Alaska. The remoteness of its habitat from the pursuits of man and the vast available food supply will make possible its existence in Alaska for a long time.

As to the Kodiak bear, its numbers are not threatened with reduction to a degree approaching the vanishing point but, fortunately, through the efforts of the Alaska Game Commission, with every cooperation from the resident population, this animal is now adequately protected. Furthermore, through the cooperation of the Alaska Game Commission and the Biological Survey, the Greenland musk ox, which was introduced on Nunivak Island, Alaska, is now showing a satisfactory increase each year, and gives promise of becoming an important game animal in the Territory.

Nor can we share the pessimism of Mr. Shoemaker regarding the deer family. In view of the present condition and numbers of the various species of deer in North America and the increasing interest in conservation and game management, there is little ground for belief that hunting or other enjoyment of deer will be limited to the Virginia whitetail only. The mule deer, especially, has become exceedingly abundant in some areas, so much so as to be the cause of great concern, and to call for definite measures of control if duplication of the situation on the Kaibab is to be avoided.

Finally, with regard to Mr. Shoemaker's feeling that: "If the Pronghorn is doomed, as some fear despite an estimate of 100,000 existing head . . . ," there seems to be little possibility that this animal's numbers will become alarmingly low. Antelope are at present decidedly on the increase, in spite of the fact that their main habitat is in the rapidly developing western country. Large refuges have been established on which antelope are thriving. A recent survey shows that there are about 186,000 in 15 western States, whereas a count made under the direction of the late Dr. E. W. Nelson during the years 1922 to 1924 showed only 26,604 in the same area. This augurs well for the future of this unique animal.—STANLEY P. YOUNG.

RECENT LITERATURE

[Conducted by Gerrit S. Miller, Jr., Remington Kellogg, and Emma M. Charters.]

ABBOTT, ROY L. Biography of a whistlepig—The animal that is supposed to look for his shadow on groundhog day was a curious pet and one that required no care while he hibernated in the home. Natural History, New York, vol. 43, no. 2, pp. 112–116, photo. February, 1939. (*Marmota monax.*)

——— Old Mister High-power. A black skunk makes an engaging house pet. Natural History, New York, vol. 43, no. 3, pp. 144–149, photo. March, 1939.

ADAM, W. G. Jungle drought. Country Life, London, vol. 72, no. 1872, pp. 636–638, 5 photos. December 3, 1932. (Ceylon wild pigs, spotted deer, bear, and leopard.)

ALDOUS, C. M. A melanistic snowshoe hare from Maine. Jour. Heredity, Washington, D. C., vol. 30, no. 1, pp. 25–26. January, 1939.

ALDOUS, SHALER E. Pine in the diet of white-tailed deer. Jour. Forestry, Washington, D. C., vol. 37, no. 3, pp. 264–267, illus. March, 1939.

ALLEE, WARDER CLYDE. The social life of animals. New York, W. W. Norton and Co., Inc., 293 pp. 1938.

ALLEN, GLOVER M. Zoological results of the second Dolan Expedition to western China and eastern Tibet, 1934–1936. Pt. 3, Mammals. Proc. Acad. Nat. Sci. Philadelphia, vol. 90, pp. 261–294, folded map, pls. 21–24. February 3, 1939.

——— A checklist of African mammals. Bull. Mus. Comp. Zool. Harvard Coll., Cambridge, Mass., vol. 83, pp. 763. February, 1939. (New: *Cryptomys natalensis nemo.*)

ALLEN, JOSEPH C. Ecology and management of Nelson's bighorn on the Nevada mountain ranges. Fourth North Amer. Wildlife Conf. Trans., Baltimore, pp. 253–256. 1939.

ALVING, TH. Aufzucht und Pflege von Walrossen. Zool. Garten, Leipzig, n. F., vol. 10, nos. 5–6, pp. 215–218, figs. 4, 1 table. January, 1939.

ANDERSON, C. The discovery of fossil marsupials in New Guinea. Rpt. 23rd meeting Australian and New Zealand Assoc. Adv. Sci., Auckland meeting, January, 1937, Wellington, vol. 23, p. 98. 1937. (*Nototherium.*)

ANDERSON, RUDOLPH MARTIN. Mammals of the Province of Quebec. Ann. Rpt. Provancher Soc. Nat. Hist. Canada, Quebec, 1938, pp. 50–114, map, + Addenda, pp. 2. February 28, 1939.

ANDRADE, RUY D'. Equídeos do fim do paleolítico e início do neolítico. Publ. Instituto de Coimbra, vol. 94, pp. 1–32. 1939.

——— O burro. Bol. Pecuário, Lisboa, Ano. 7, no. 1, pp. 5–22, figs. 73, tables. 1939.

ANONYMOUS. Zebu cattle in Brazil. Pastoral Review and Graziers Record, Melbourne, p. 1348. 1937.

——— La faune des parc nationaux. Le Nat. Canadien, Quebec, vol. 65 (ser. 3, vol. 9), nos. 8–9, pp. 237–238. August–September, 1938.

——— Big horn sheep. Arizona Wildlife and Sportsman, Phoenix, vol. 1, no. 1, p. 4. January, 1939.

——— Pandora enjoys her breakfast: A giant panda's diet in captivity. Illus. London News, vol. 194, no. 5203, p. 29, photos 5. January 7, 1939.

——— The world's rarest monkey for the Zoo: The golden snub-nosed monkey from south-western China. Illus. London News, vol. 194, no. 5205, p. 103, illus. January 21, 1939. (*Rhinopithecus.*)

ANONYMOUS. Record moose antlers. Natural History, New York, vol. 43, no. 1, p. 51, illus. January, 1939. (Spread, 6 ft. 5½ in.; weight, 60 lbs.)

——— Big-game inventory of the United States, 1937. U. S. Dept. Agric., Wildlife Research and Management Leaflet BS-122, pp. 1–13, tables 17. January, 1939.

——— [Photograph of coatimundi, South American raccoon shot in Cumberland-York County hills, Pa.—an escaped pet.] Penn. Game News, New Cumberland, Pa., p. 27, fig. February, 1939.

——— The Swanscombe skull. Nature, London, vol. 143, no. 3614, pp. 187–188. February 4, 1939.

——— Colonization of Krakatau by mammals. Nature, London, vol. 143, no. 3617, p. 339. February 25, 1939.

——— Cooperative wildlife-management research, 1938. U. S. Bur. Biol. Surv. Wildlife Research and Management Leaflet BS-129, Washington, D. C., pp. 4, tables 3. March, 1939.

——— The Rhinoceros in the Paris basin. Nature, London, vol. 143, no. 3613, p. 174. January 28, 1939.

——— Additional evidence of early man in America. Nature, London, vol. 143, no. 3613, p. 173. January 28, 1939.

——— A fossil whale from Australia. Nature, London, vol. 143, no. 3621, p. 525. March 25, 1939. (*Mammalodon.*)

——— The red fox in North Dakota. North Dakota Outdoors, Bismarck, vol. 1, no. 7, pp. 11–12. January, 1939.

——— Wildlife in North Dakota. North Dakota Outdoors, Bismarck, vol. 1, no. 7, pp. 27–30. January, 1939.

ANTONIUS, OTTO. Zur Rückzüchtung des polnischen Wildpferdes. Zool. Garten, Leipzig, n. F., vol. 10, nos. 3–4, pp. 102–107, figs. 10. September, 1938.

ARGYROPULO, A. I. New Cricetidae (Glires, Mammalia) from the Oligocene of Middle Asia. Comptes Rendus (Doklady) Acad. Sci. URSS, Moscou, n. s., vol. 23, no. 1, pp. 111–114, fig. 1. 1939. (New: *Eumysodon, E. spurius, E. orlovi, Aralomys, A. gigas.*)

——— Occurrence of genus *Schaubeumys* Wood (Cricetidae, Mammalia) in the upper Oligocene of Middle Asia. Comptes Rendus (Doklady) Acad. Sci. URSS, Moscou, n. s., vol. 23, no. 2, pp. 206–208, illus. 1939. (New: *Schaubeumys aralensis, S. woodi.*)

ASHLEY-MONTAGU, M. F. Adolescent sterility. Quart. Review Biol., Baltimore, vol. 14, no. 1, pp. 13–34. March, 1939.

ASTRE, GASTON. Faune des grottes du Tambou, de la Terre et de la Caougno à Montségur-le-Château. Bull. Soc. Hist. Nat. Toulouse, vol. 70, pt. 4, pp. 362–366. December 30, 1936.

——— Vertébrès Miocènes de Lussan, Montiron, Lahas, Sauveterre et Espaon. Bull. Soc. Hist. Nat. Toulouse, vol. 70, pt. 4, pp. 367–373. December 30, 1936.

——— Mammouth des nappes alluviales de Bram. Compte Rendu Sommaire Soc. Géol. France, Paris, no. 4, pp. 52–54. February 20, 1939.

BACHOFEN-ECHT, AD. Die fossilen Geweihe von *Cervus elaphus* und ihre Beziehungen zu den lebenden Formen. Palaeont. Zeitschr., Berlin, vol. 21, no. 1, pp. 68–76, pls. 1–6. January 1, 1939.

BAGLEY, LESTER. Feeding elk in Wyoming. Wyoming Wild Life, Cheyenne, vol. 4, nos. 2–3, pp. 1–2. February-March, 1939.

BAHLCKE, H. Aufbau einer Nerz-stammzucht. Deutsche Pelztierzüchter, München, vol. 14, no. 6, pp. 121–126. March 15, 1939.

——— Was ist im neuen Zuchtjahr notwendig? Deutsche Pelztierzüchter, München, vol. 14, no. 3, pp. 49–51. February 1, 1939.

BAILEY, VERNON. Shorty, the shrew. Nature Magazine, Washington, D. C., vol. 32, no. 1, pp. 12–14, illus. January, 1939. (*Blarina brevicauda.*)

BAKALOV, PETER. Mastodonreste von Pisarewo, Bez. Plewen, Nordbulgarien. Festschr. 60 geburtstage Prof. Dr. Embrik Strand, Riga, vol. 5, pp. 84–86. February 28, 1939.

BALDWIN, FRANCIS MARCH, AND HAROLD D. ROBINSON. Effect of oxygen pre-breathing on anoxemia in albino rats. Proc. Soc. Exper. Biol. and Med., New York, vol. 40, no. 2, pp. 255–256, table 1. February, 1939.

BARRETT, CHARLES. Koala. The story of Australia's native bear. Robertson and Mullens, Melbourne, Australia, 31 pp., 15 pls. 1937.

BARTLETT, I. H. Whitetails. Presenting Michigan's deer problem. Michigan Conservation, Lansing, vol. 8, no. 6, pp. 6–7, illus. February, 1939.

——— Whitetails. Presenting Michigan's deer problem. Pennsylvania Game News, New Cumberland, vol. 9, no. 12, pp. 12–14, 29. March, 1939.

BARTON, D. R. How bright is the dog? Natural History, New York, vol. 43, no. 2, pp. 117–123, illus. February, 1939.

BASSETT, CHARLES F. An efficient trap for the fox ranch. U. S. Bur. Biol. Surv. Wildlife Research and Management Leaflet BS-127, pp. 1–2, figs. 3. March, 1939.

——— A feeder for foxes. U. S. Bur. Biol. Surv. Wildlife Research and Management Leaflet BS-128, pp. 1–2, fig. 1, March, 1939.

BATE, D. M. A. The fossil fauna of the Wady el-Mughara Caves. The Stone Age of Mount Carmel—Excavations at the Wady el-Mughara, vol. 1, (Palaeontology pt. 2), pp. 137–240, figs. 8, 1 chart. 1937. (*Crocidura samaritana*, substitute name for *Crocidura xanthippe* preoccupied.)

——— Animal remains. [In] P. L. O. Guy, and Robert M. Engberg, Megiddo Tombs, Oriental Inst. Publ., Univ. Chicago, vol. 33, pp. 209–213, figs. 204–206. 1938.

BENNETT, WILLIAM H. Observations on the behaviour of the European hare when pursued by hounds. Canadian Field-Nat., Ottawa, vol. 53, no. 1, pp. 6–7. January, 1939.

BENNITT, RUDOLF. Wildlife research in Missouri. Missouri Wildlife, Springfield, vol. 1, no. 7, pp. 9, 13–14. February, 1939.

BENSON, SETH B., AND DANIEL F. TILLOTSON. Descriptions of two subspecies of pocket gopher (*Thomomys bottae*) from Sonora. Proc. Biol. Soc. Washington, vol. 52, pp. 151–153. October 11, 1939. (New: *Thomomys bottae occipitalis*, *Thomomys bottae estanciae.*)

BENSON, SETH B. Descriptions and records of harvest mice (Genus *Reithrodontomys*) from Mexico. Proc. Biol. Soc. Washington, vol. 52, pp. 147–150. October 11, 1939. (New: *Reithrodontomys burti*, *Reithrodontomys fulvescens canus.*)

BLAIR, W. FRANK. New mammals from Texas and Oklahoma, with remarks on the status of *Thomomys texensis* Bailey. Occas. Papers Mus. Zool., Univ. Michigan, Ann Arbor, no. 403, pp. 2–7. June 16, 1939. (New: *Thomomys bottae limpiae*, *Neotoma albigula robusta*, *Neotoma floridana osagensis.*)

BLUNTSCHLI, H. Neues zum Problem der Befruchtung. Ovulation und Implantation des Säugetierkeimes. Praxis, Schweizerische Rundschau f. Medizin, Bern, no. 1, pp. 1–4. January 5, 1939.

Boeder, M. Der Sumpfbiber im winter. Deutsche Pelztierzüchter, München, vol. 14, no. 6, pp. 131–133. March 15, 1939.

Boggess, Stanley T. America's No. 1, big game animal. Pennsylvania Game News, New Cumberland, vol. 9, no. 12, pp. 16–17. March, 1939. (Deer.)

Boissiere, G. Études spéléologiques dans les Alpes Maritimes. La Géographie, Paris, vol. 67, no. 1, pp. 1–9, figs. 3. January, 1937.

Bond, Richard M. Observations on raptorial birds in the lava beds—Tule Lake region of northern California. Condor, vol. 41, no. 2, pp. 54–61. March, 1939. (Contains lists of mammals eaten by birds.)

Boschma, H. On the teeth and some other particulars of the sperm whale (*Physeter macrocephalus* L.). Temminckia, Leiden, vol. 3, pp. 151–278, pls. 10–13, figs. 1–19. 1938.

Brandes, Gustav von. Die Stillzeit des Orang. Zool. Garten, Leipzig, n. F., vol. 10, nos. 3–4, pp. 139–141. September, 1938. (Nursing period of a young orang 6½ years.)

———— Buschi: Vom Orang-Saügling zum Backenwülster. Quelle and Meyer, Leipzig, 135 pp., 155 figs. March, 1939. Cloth, R. M. 4.80. (Account of the life history, development, and behavior of an orang born in the Dresden Zoological Gardens, with observations on other orangs.)

Branin, Manlif Lelyn. Some small mammals of Mount Desert Island, Maine. Occas. Papers Boston Soc. Nat. Hist., vol. 8, pp. 311–320, map, tables 2. January 6, 1939.

Brassard, J. A., and Richard Bernard. Observations on breeding and development of marten, *Martes a. americana* (Kerr). Canadian Field-Nat., Ottawa, vol. 53, no. 2, pp. 15–21, figs. 4. February, 1939. (Gestation period 220–230 days. Young weaned at 6 or 7 weeks. Adult weight attained in 3 months.)

Broek, A. J. P. van den. The Pleistocene human skull from Hengelo. II. Anthropological part. Proc. Sect. Sci., Kon. Akad. Wetensch. Amsterdam, vol. 39, no. 1, pp. 81–82, fig. 1936.

Broman, Ivar. Einige Erfahrungen aus einer Giraffenjagd. Zool. Garten, Leipzig, n. F., vol. 10, nos. 3–4, pp. 84–94, figs. 5, 1 table. September, 1938.

Burgl, Hans. Morphologische und funktionelle Analyse der Wirbelsäule des Höhlenbären. II. Palaeobiologica, Wien, vol. 7, no. 1, pp. 47–80, figs. 6. March 16, 1939.

Burke, J. J. A new cylindrodont rodent from the Oligocene of Montana. Ann. Carnegie Mus., Pittsburgh, vol. 27, pp. 255–274, figs. 4, pls. 26–27. October 22, 1938. (New: *Pseudocylindrodon medius*.)

Burrell, Harry. The platypus "*Ornithorynchus paradoxus*." The Koala Mag., Sydney, pp. 16–17, illus. October, 1937. (Excellent photographs of nests and young.)

Burroughs, R. D. An analysis of hunting records for the prairie farm project, Saginaw County, Michigan, 1937. Jour. Wildlife Manag., Menasha, Wisc., vol. 3, no. 1, pp. 19–25. January, 1939.

Cain, James M. Fit for a queen—worth a king's ransom. McCall's Magazine, New York, vol. 64, no. 6, pp. 16, 67, 75, illus. March, 1937. (Chinchillas.)

Campbell, Berry. The shoulder anatomy of the moles. A study in phylogeny and adaptation. Amer. Jour. Anat., Philadelphia, vol. 64, no. 1, pp. 1–39, figs. 62, table 1. January 15, 1939.

Carpenter, C. R. A survey of wild life conditions at Atjeh, North Sumatra. With special reference to the orang-utan. Communications No. 12, Netherlands Comm. Internat. Nature Protection, Amsterdam, pp. 34, maps 3, 1 photo. 1938.

CARRICK, ROBERT. Some parasites of birds and mammals from Canna. Scottish Nat., Edinburgh, no. 235, pp. 23–24. January-February, 1939.

CASTARET, NORBERT. La colonie de murins de la grotte des Tignahustes. Mammalia, Paris, vol. 3, no. 1, pp. 1–9, map. March, 1939.

CHANG, CHANG-YING, AND HSIEN WU. Growth and reproduction of laboratory bred hamsters, *Cricetulus griseus*. Chinese Jour. Physiol, Peking, vol. 13, no. 1, pp. 109–118, figs. 5, tables 3. March 15, 1938.

CHASE, RALPH E., AND CHARLES F. DE GARIS. Arteriae coronariae (cordis) in the higher Primates. Amer. Jour. Phys. Anthrop., Philadelphia, vol. 24, no. 3, pp. 427–448, figs. 4, table 1. January-March, 1939.

CHASEN, F. N. Four new mammals from Java. Treubia, Buitenzorg, vol. 17, no. 3, pp. 185–188. August, 1939. (New: *Petinomys bartelsi*, *Otomops formosus*, *Glischropus javanus*, and *Rhinolophus importunus*.)

——— Two new mammals from North Sumatra. Treubia, Buitenzorg, vol. 17, no. 3, pp. 207–208. August, 1939. (New: *Rattus hoogerwerfi*, and *Rattus bukit lieftincki*.)

CLARK, JOHN. Certain possibilities in the field study of vertebrate fossils. Jour. Paleont., Menasha, Wisc., vol. 13, no. 1, pp. 137–139. January, 1939.

——— Status of the Oligocene insectivore genus Metacodon. Jour. Paleont., Menasha, Wisc., vol. 13, no. 1, pp. 139–140. January, 1939.

——— Miacis gracilis, a new carnivore from the Uinta Eocene. Ann. Carnegie Mus., Pittsburgh, vol. 27, pp. 349–370, figs. 2, pls. 34–37. November 6, 1939. (New: *Miacis gracilis*.)

CLARKE, C. H. D. Some notes on hoarding and territorial behavior of the red squirrel *Sciurus hudsonicus* (Erxleben). Canadian Field-Nat., Ottawa, vol. 53, no. 3, pp. 42–43. March, 1939.

COCKBURN, J. SCOTT. Carclew's first Kadir cup. A pigsticking memory that cannot fade. The Field, London, vol. 164, no. 4275, pp. 1300–1301, illus. December 1, 1934.

COGHILL, G. E. Early movements of the opossum with special reference to the walking gait. Proc. Soc. Exper. Biol. and Med., New York, vol. 39, no. 1, pp. 31–35. October, 1938.

COLBERT, EDWIN. Wild dogs and tame—Past and Present—A panorama of the origin, genealogy and "social" background of the tractable wolf that emerged from the wilderness to become man's best friend. Natural History, New York, vol. 43, no. 2, 90–95, illus. February, 1939.

F. C. Field notes on roan. The Nigerian Field, London, vol. 8, no. 1, p. 10, colored frontispiece. January, 1939.

F. C. Field notes on white Oryx. The Nigerian Field, London, vol. 8, no. 1, pp. 10–11. January, 1939.

COLLIER, F. S. A shooting trip to Termitt. The Nigerian Field, London, vol. 8, no. 1, pp. 14–20, figs. 8. January, 1939. (Figures of Addax bull and Barbary sheep.)

CONGER, W. B. The real cougar. Nature Magazine, Washington, D. C., vol. 31, no. 8, pp. 491–492. October, 1938.

COOK, J. B. Pocket gophers spread Canada thistle. Bull. Dept. Agric. California, Sacramento, vol. 28, no. 2, pp. 142–143, figs. 2. February, 1939.

CRIDDLE, STUART. The thirteen-striped ground squirrel in Manitoba. Canadian Field-Nat., Ottawa, vol. 53, no. 1, pp. 1–6. January, 1939.

DALQUEST, WALTER W. Abnormal mammal skulls from Washington. Murrelet, Seattle, vol. 20, no. 1, p. 19. January–April, 1939. (*Lynx rufus fasciatus*, *Odocoileus hemionus*.)

DAMMERMAN, K. W. On jalorensis-rats and other mammals from the Krakatau Islands. Treubia, Buitenzorg, vol. 16, no. 4, pp. 421–443. November, 1938.

DARLING, F. FRASER. I lived with seals. Discovery, Cambridge, England, n. s., vol. 2, no. 12, pp. 112–120, illus. March, 1939. (North Rona Island; life history observations on gray seal.)

DATHE, HEINRICH. Georg Grimpe. Zeitschr. f. Säugetierkunde, Berlin, vol. 11, pp. 336–337, photo. December 30, 1936.

DAUBENMIRE, REXFORD F. Merriam's life zones of North America. Quart. Rev. Biol., Baltimore, vol. 13, no. 3, pp. 327–332. September, 1938.

DAVENPORT, CHARLES BENEDICT. Post-natal development of the human outer nose. Proc. Amer. Philos. Soc., Philadelphia, vol. 80, no. 2, pp. 175–355, figs. 84 + A, B, C, tables 4, pls. 1–18. January 31, 1939.

DAY, C. D. The descent of the testes in the pig; intra-abdominal pressure suggested as a cause. Jour. Tennessee Acad. Sci., Nashville, vol. 9, no. 1, pp. 18–46. 1934.

DEYSACH, L. J. The comparative morphology of the erectile tissue of the penis with especial emphasis on the probable mechanism of erection. Amer. Jour. Anat., Philadelphia, vol. 64, no. 1, pp. 111–131, 2 pls. January 15, 1939.

DICE, LEE R. A simple method for filing miniature negatives and microfilm records in strips. Science, n. s., vol. 89, no. 2298, pp. 39–40. January 13, 1939.

——— Variation in the cactus-mouse, *Peromyscus eremicus*. Contrib. Lab. Vert. Genetics, Univ. Michigan, Ann Arbor, no. 8, pp. 1–27, map. 1, tables 5. March, 1939.

——— Variation in the wood-mouse, *Peromyscus leucopus*, from several localities in New England and Nova Scotia. Contrib. Lab. Vert. Genetics, Univ. Michigan, Ann Arbor, no. 9, pp. 1–16, map, tables 2. March, 1939.

DIDIER, ROBERT, AND PAUL RODE. Les micromammifères de la Faune française. I. Campagnols. Mammalia, Paris, vol. 3, no. 1, pp. 19–37, figs. 11, pl. 2. March, 1939.

DOENGES, JAMES L. Spiorchetes in gastric glands of *Macacus rhesus* and humans without definite history of related disease. Proc. Soc. Exper. Biol. and Med., New York, vol. 38, no. 4, pp. 536–538. May, 1938.

DOLLMAN, GUY. Post-natal development of kangaroos. Proc. Linnean Soc. London, 151st sess., pt. 1, pp. 19–23, pls. 1–2. February 3, 1939.

DOUGHERTY, R. W. Sickle cells in the blood of western deer. Jour. Wildlife Manag., Menasha, Wisc., vol. 3, no. 1, pp. 17–18. January, 1939.

DOUTT, J. KENNETH. The expedition to Hudson Bay. Carnegie Mag., Pittsburgh, vol. 12, no. 8, pp. 227–236, illus. January, 1939.

DRESCHER, ARTHUR B. A new Pliocene badger from New Mexico. Bull. S. California Acad. Sci., Los Angeles, vol. 38, pt. 2, pp. 57–62, pl. 13. May–August, 1939. (New: *Taxidea mexicana*.)

DREW, G. C. McDougall's experiments on the inheritance of acquired habits. Nature, London, vol. 143, no. 3614, pp. 188–191. February 4, 1939. (Results not convincing; see MacBride.)

DUBOIS, EUG. Over den *Pithecanthropus erectus*. Natuurhist. Maandblad, Maastricht, 27e Jaargang, no. 9, pp. 92–95, illus. September 30, 1938. (Skull was not balanced on top of vertebral column.)

DUNKLE, DAVID HOSBROOK. A lower jaw of *Martinogale alveodens* Hall. Univ. Kansas Sci. Bull., Lawrence, vol. 25, no. 8, pp. 181–184, pl. 21. July 10, 1939.

DURRANT, STEPHEN D. A new pocket gopher of the *Thomomys quadratus* group from the northern Great Basin Region. Bull. Univ. Utah, vol. 29, no. 6, pp. 6. February 28, 1939. (New: *Thomomys quadratus gracilis*.)

DURRANT, STEPHEN D. Two new gophers (Mammalian genus *Thomomys*) from western Utah. Proc. Biol. Soc. Washington, vol. 52, pp. 159–162. October 11, 1939. (New: *Thomomys bottae convexus, Thomomys bottae minimus.*)

DURRANT, STEPHEN D., AND E. RAYMOND HALL. Deux sous-espèces nouvelles du rongeur *Dipodomys ordii* de l'ouest des États-Unis d'Amérique. Mammalia, Paris, vol. 3, no. 1, pp. 10–16, pl. 1. March, 1939. (New: *Dipodomys ordii celeripes, D. o. fetosus.*)

EHRENBERG, KURT, OTTO SICKENBERG, AND ANGELA STIFFT-GOTTLIEB. Die Fuchs- oder Teufelslucken bei Eggenburg Niederdonau. Abhandl. Zool.-Bot. Gesell. Wien, vol. 17, no. 1, pp. 1–130, pls. 1–18. 1938. (*Hyaena spelaea* pp. 24–130, pls. 5–18.)

ELDER, JAMES H. Puerperal hemorrhage in chimpanzees. Amer. Jour. Obstetrics and Gynecology, St. Louis, vol. 37, no. 2, pp. 327–329, table 1. February, 1939.

ENDERS, ROBERT KENDALL. Panniculus carnosus and formation of the pouch in didelphids. Jour. Morph., vol. 61, no. 1, pp. 1–26. 1937.

——— Mink breeding through the microscope. Amer. Fur Breeder, Duluth, vol. 11, no. 7, pp. 6, 8, figs. 4. January, 1939.

ENGLÄNDER, HANS. Beobachtungen an Kleinen Hufeisennasen (*Rhinolophus hipposideros* (Bechst.)) in Gefangenschaft. Zool. Garten, Leipzig, n. F., vol. 10, nos. 5–6, pp. 221–224. January, 1939.

ERICKSON, ARNOLD B. Parasites of some Minnesota Cricetidae and Zapodidae, and a host catalogue of helminth parasites of native American mice. Amer. Midland Nat., Notre Dame, vol. 20, no. 3, pp. 575–589. November, 1938.

EVANS, CHARLES A. Observations on hibernating bats with especial reference to reproduction and splenic adaptation. Amer. Nat., Lancaster, Pa., vol. 72, no. 742, pp. 480–484. September–October, 1938.

FINLAYSON, H. H. On mammals from the Lake Eyre Basin. Pt. 3. The diprotodont marsupials and ornithodelphia. Trans. Roy. Soc. S. Australia, Adelaide, vol. 60, pp. 157–161. 1936.

FISHER, R. A., E. B. FORD, AND JULIAN HUXLEY. Taste-testing the anthropoid apes. Nature, London, vol. 144, no. 3652, p. 750. October 28, 1938.

FISKE, VIRGINIA M. Effects of light and darkness on activity of the pituitary of the rat. Proc. Soc. Exper. Biol. and Med., New York, vol. 40, no. 2, pp. 189–191, tables 2. February, 1939.

FLEROV, K. K. Remains of Ungulata from Bet-Pak-Dala. Comptes Rendus (Doklady) Acad. Sci. URSS, Moscou, n. s., vol. 23, nos. 1–2, pp. 94–96. 1938.

FOX, HERBERT. Chronic arthritis in wild mammals. Trans. Amer. Philos. Soc., Philadelphia, n. s., vol. 31, pt. 2, pp. 73–148, pls. 12. February, 1939.

FRANCIS, CARL C., AND PETER P. WERLE. The appearance of centers of ossification from birth to 5 years. Amer. Jour. Phys. Anthrop., Philadelphia, vol. 24, no. 3, pp. 272–299, figs. 2, tables 4. January–March, 1939. (*Homo*)

FRANZ, V. Der gegenwärtige Stand der Stangenelch-Frage [*Alces alces* (L) var.]. Zool. Anz., Leipzig, vol. 125, nos. 3–4, pp. 81–87. February 1, 1939.

FRECHKOP, S. Exploration du Parc National Albert. Mission G. F. Witte (1933–1935), fasc. 10, Mammifères. Publ. Parcs Nat. Congo Belge, Bruxelles, pp. 103, pls. 19, maps 2, figs. 5. 1938.

——— Mammifères et Oiseaux protégés au Congo Belge. Publ. Inst. Parcs Nat. Congo Belge, Bruxelles, pp. 87, illus., map. (Mammals, pp. 10–53). 1936.

FRONK, CLARENCE E. Big-game hunting in Indo-China. Pan-Pacific, Hawaii, vol. 2, no. 3, pp. 47, 48, 58, illus. October–December, 1938.

GAZIN, C. LEWIS. A further contribution to the Dragon Paleocene fauna of central Utah. Jour. Washington Acad. Sci., vol. 29, no. 7, pp. 273–286, figs. 10.

July 15, 1939. (New: *Catopsalis utahensis, Conoryctella, C. dragonensis, Anisonchus dracus, A. onostus, Haploconus inopinatus, Dracoclaenus, D. griphus, Ellipsodon shepherdi, Ellipsodon? sternbergi, Jepsenia, J. mantiensis.*)

GODWIN, MELVIN CRAWFORD. The mammalian thymus. IV. The development in the dog. Amer. Jour. Anat., Philadelphia, vol. 64, no. 1, pp. 165–192. January 15, 1939.

GOODWIN, GEORGE. The first white giraffe seen in Kenya: an adult "albino" bull. Illus. London News, vol. 194, no. 5213, p. 421, illus. March 18, 1939.

GREGORY, WILLIAM K. Biographical memoir of Henry Fairfield Osborn 1857–1935. Nat. Acad. Sci., Washington, Biographical Memoirs, vol. 19, no. 3, pp. 53–119, photo. 1938.

GREULICH, WILLIAM W., AND THOMAS HERBERT. A study of pelvic type and its relationship to body build in white women. Jour. Amer. Med. Assoc., Chicago, vol. 112, no. 6, pp. 485–493, figs. 1–10. February 11, 1939. (The "normal" female type of the text books was found in only 14.9 per cent of 582 primigravid white women. Only 31.9 per cent of 196 adults had the type of pelvis which, according to the anthropologic literature is proper for white women (p. 492).)

GRIFFITH, J. Q., B. I. COMROE AND C. J. ZINN. Studies of blood volume in ergotamine tartrate poisoning in rats. Proc. Soc. Exper. Biol. and Med., New York, vol. 40, no. 2, pp. 177–179. February, 1939.

HALL, E. RAYMOND, AND DAVID H. JOHNSON. Mammals from Millard County, Utah. Proc. Utah Acad. Sci., Arts and Letters, Salt Lake City, vol. 15, pp. 121–122. 1938.

HALL E. RAYMOND, AND H. LORRAINE BOWLUS. A new pika (Mammalian genus *Ochotona*) from southeastern Idaho with notes on near-by subspecies. Univ. Calif. Publ. Zool., Berkeley, vol. 42, no. 6, pp. 335–340, fig. 1. October 12, 1938. (New: *Ochotona princeps clamosa.*)

HALL, E. RAYMOND, AND WALTER W. DALQUEST. Three new pocket gophers (Mammalian genus *Thomomys*) from Washington. Murrelet, Seattle, vol. 20, no. 1, pp. 3–5. April 30, 1939. (New: *Thomomys talpoides devexus, T. t. immunis, T. t. yakimensis.*)

HAMERSTROM, F. N., AND JAMES BLAKE. A fur study technique. Jour. Wildlife Manag., Menasha, Wisc., vol. 3, no. 1, pp. 54–59. January, 1939.

HAMPE, IRVING E. The occurrence and breeding of the Maryland shrew (*Sorex fontinalis*) in the Patapsco State Park. Bull. Nat. Hist. Soc. Maryland, Baltimore, vol. 7, no. 4, pp. 17–18. December, 1936. (Mimeographed.)

HARRIS, CHARLES E. Whaling prints. Avocations, New York, vol. 3, no. 4, pp. 213–217, 4 prints. January, 1939.

HATHAWAY, I. L., H. P. DAVIS, R. P. REECE, AND J. W. BARTLETT. Effect of pregnancy urine extract on lactation in the rat. Proc. Soc. Exper. Biol. and Med., New York, vol. 40, no. 2, pp. 214–218, table 1. February, 1939.

HELPING, HERMANN. Zur odontologischen Charakteristik des Pseudarctos-Gebisses. Verhandl. Schweiz. Naturforsch. Gesell., Aarau, 117 Jahresversammlung vom 28. bis 30. August, 1936 in Solothurn, p. 301. 1936.

HEPTNER, V. G. A new subspecies of vole from Turkestan. Ann. Mag. Nat. Hist., London, ser. 11, vol. 4, no. 20, pp. 192–193. August, 1939. (New: *Microtus (Chionomys) nivalis dementievi.*)

HESCHELER, K. Nochmals ein ungewöhnliches Fundstück von einem diluvialen Elephanten. Eclogae geol. Helvetiae, Basel, vol. 31, no. 2, p. 296. December, 1938.

HESTON, WALTER E. Bent-nose in the Norway rat. Jour. Heredity, Washington, D. C., vol. 29, no. 11, pp. 437–448. November, 1938.

[HIBBARD, CLAUDE W.] Nekrolagus, new name for Pediolagus Hibbard, not Marelli. Amer. Midland Nat., Notre Dame, vol. 21, table of contents, p. [2] July, 1939. (New: *Nekrolagus*, substitute name for *Pediolagus* Hibbard, preoccupied.)

HICKIE, PAUL. Rabbits—and some of the costly myths about restocking them. Importation. Michigan Conservation, Lansing, vol. 8, no. 6, pp. 4, 8, 10, 11, illus. February, 1939.

HILL, ALFRED H. Fetal age assessment by centers of ossification. Amer. Jour. Phys. Anthrop., Philadelphia, vol. 24, no. 3, pp. 251–272, tables 14. January–March, 1939. (*Homo*)

HILL, W. C. OSMAN. Observations on a giant Sumatran orang. Amer. Jour. Phys. Anthrop., Philadelphia, vol. 24, no. 3, pp. 449–510, figs. 5, pls. 1–5, tables 8. January–March, 1939.

——— A revised check-list of the mammals of Ceylon. Ceylon Jour. Sci. sect. B, Zool. and Geol., vol. 21, pt. 2, pp. 139–184. February 10, 1939.

——— On the neonatus in *Ratufa* and *Funambulus* (Mammalia; Sciuridae). Ceylon Jour. Sci. sect B, Zool. and Geol., vol. 21, pt. 2, pp. 189–191. February 10, 1939.

HILZHEIMER, M. Eine Hauskatze mit Hängeohren. Sitz.-Ber. Gesell. Naturf. Freunde Berlin, Jahrg., 1938, pp. 91–93, fig. 1938.

HOLZAPFEL, MONIKA. Über Bewegungsstereotypien bei gehaltenen Säugern. III. Mitteilung: Analyse der Bewegungsstereotypie eines Gürteltieres (*Dasypus villosus* Desm.). Zool. Garten, Leipzig, n. F., vol. 10, nos. 5–6, pp. 184–193, figs. 3. January, 1939.

HORNADAY, WILLIAM T. The psychology of wild animals. North Dakota Outdoors, Bismarck, vol. 1, no. 8, pp. 16–19. February, 1939.

HUEY, LAURENCE M. A new *Perognathus arenarius* from near the U. S.-Mexican boundary in Lower California. Trans. San Diego Soc. Nat. Hist., vol. 9, no. 13, pp. 57–58. August 31, 1939. (New: *Perognathus arenarius mexicalis*.)

——— Kit fox and camera. Nature Mag., Washington, D. C., vol. 31, no. 10, pp. 587–588. December, 1938.

——— The silky pocket mice of southern California and northern Lower California, Mexico, with the description of a new race. Trans. San Diego Soc. Nat. Hist., vol. 9, no. 11, pp. 47–54, map, table. August 31, 1939. (New: *Perognathus longimembris internationalis*.)

——— A new silky pocket mouse from southwestern Utah. Trans. San Diego Soc. Nat. Hist., vol. 9, no. 12, pp. 55–56. August 31, 1939. (New: *Perognathus longimembris virginis*.)

INGLES, LLOYD G. In defense of the lion. Amer. Forests, Washington, D. C., vol. 45, no. 1, pp. 21–22. January, 1939. (A plea for conserving the mountain lion as a game animal.)

JACKSON, C. F. Notes on the range of the Labrador shrew, *Sorex cinereus miscix*. Canadian Field-Nat., Ottawa, vol. 53, no. 1, pp. 7–8. January, 1939.

——— A new subspecies of Peromyscus from the north shore of the Gulf of St. Lawrence. Proc. Biol. Soc. Washington, vol. 52, pp. 101–104. June 5, 1939. (New: *Peromyscus maniculatus plumbeus*.)

JACKSON, C. M. The nature of the abnormally rapid increase in weight upon refeeding after a period of growth suppression. Amer. Jour. Anat., Philadelphia, vol. 64, no. 1, pp. 41–58. January 15, 1939.

JONES, FREDERIC WOOD. The "thumb" of the giant panda. Nature, London, vol. 143, no. 3613, p. 157. January 28, 1939.

——— The "thumb" of the giant panda. Nature, London, vol. 143, no. 3615, p. 246. February 11, 1939.

JUHE, H., AND J. LANGLET. Die Bedeutung der Karakul. Zeitschr. für Schafzucht, Hanover, pp. 189–205, 213. 1938.

KAUFMANN, JULIUS. Welche Ursachen können eine geringe Vermehrung beim Sumpfbiber bewirken. Deutsche Pelztierzüchter, München, vol. 14, no. 3, pp. 51–52. February 1, 1939.

KELLOGG, REMINGTON. Annotated list of Tennessee mammals. Proc. U. S. Nat. Mus., vol. 86, no. 3051, pp. 245–303. February 14, 1939.

KELWAY, PHYLLIS. The dormouse. Game and Gun and Angler's Monthly, London, vol. 16, no. 160, pp. 33–36, illus. January, 1939.

KLEINBERG, S. E. Quelques données sur l'alimentation de *Tursiops tursio* Fabr. dans la Mer Noire. Bull. Soc. Nat. Moscou, sect. Biol., n. s., vol. 47, nos. 5–6, pp. 406–413. 1938. (Food consists of: turbot (*Bothus maeoticus*), cod (*Gadus euxinus*), isopod (*Idothea algirica*), anchovy (*Engraulis encrosicholus*), skate (*Raja clavata*), prawn (*Crangon crangon*), croaker (*Umbrina cirrhosa*), red mullet (*Mullus barbatus*), scorpion fish (*Scorpaena porcus*), gray mullet (*Mugil* sp.), and Mollusca including *Cardium* sp., *Nassa reticulata*, *Modiola fasceolina*, *Sindesmia* sp., *Cardium simile*, *Mytilus* sp.)

——— On the methods of estimating the stocks of the Black Sea dolphin (*Dolphinus* [sic] *delphis ponticus* Barabasch). Comptes Rendus (Doklady) Acad. Sci. URSS, Moscou, n. s., vol. 23, no. 5, pp. 495–498, tables 3. 1939. (Catch as follows: 5815 in 1933, 20830 in 1934, and 11628 in 1935.)

KOBY, F.-ED. Une nouvelle station préhistorique (paléolithique, néolithique, âge du bronze): les cavernes de St.-Brais Jura bernois. Verhandl. Naturf. Gesell. in Basel, vol. 49, 1937–38, pp. 138–196, figs. 16. July 3, 1938.

KOCH, W. Beeinflussung der Fortpflanzung der Füchse mit Hilfe von Hormonen. Deutsche Pelztierzüchter, München, vol. 14, no. 1, pp. 2–6. January 1, 1939.

——— Beeinflussung der Fortpflanzung der Füchse mit Hilfe von Hormonen. Deutsche Pelztierzüchter, München, vol. 14, no. 2, pp. 30–34. January 15, 1939.

KOHLER, G. O., S. B. RANDLE, C. A. ELVEHJEM, AND E. B. HART. Simplified rations for guinea pigs suitable for assay of the grass juice factor. Proc. Soc. Exper. Biol. and Med., vol. 40, no. 2, pp. 154–157, chart 1. February, 1939.

KREMBS, J. Auf Waschbären übertragbare Katzenseuche. Deutsche Pelztierzüchter, München, vol. 14, no. 4, pp. 77–80. February 15, 1939.

KRIEG, HANS. Mechanische Bedingtheit in der Entwicklung der Organismen. Die Naturwissenschaften, Berlin, 25. Jahrg., no. 47, pp. 757–762, figs. 6. 1937.

KROGMAN, WILTON MARION. (Obituary) Thomas Wingate Todd: January 15, 1885–December 28, 1938. Science, n. s., vol. 89, no. 2303, pp. 143–144. February 17, 1939.

KÜHLHORN, FRIEDRICH. Beitrag zur Systematik der südamerikanischen Caniden. Archiv f. Naturgesch., Leipzig, n. F., vol. 7, no. 1, pp. 29–45, figs. 5, tables. 1938.

——— Anpassungserscheinungen am Kauapparat bei ernährungsbiologisch verschiedenen Säugetieren. Zool. Anz., Leipzig, vol. 121, nos. 1–2, pp. 1–17, figs. 3, table 1. January 1, 1938.

——— Das Riesengürteltier (*Priodontes giganteus* E. Geoffr.) als Anpassungsform. Zool. Garten, Leipzig, n. F., vol. 10, nos. 3–4, pp. 107–114, figs. 10. September, 1938.

KVAŠNINAS-SAMARINAS, M. Wisentfunde in Litauen und Klassifizierungsfrage. Mem. Faculté Sci. Univ. Vytautas le Grand, Kaunas, vol. 7, pp. 491–517, tables 5. 1933. (In Latvian, with Germany summary.)

LAMBERTON, C. Contribution à la connaissance de la faune subfossile de Madagascar. Mém. Acad. Malgache, Tananarive, no. 27, pp. 5–203, figs. 8, pls. 28, tables 6. 1939. (New: *Propithecus verreauxioides, Neopropithecus, N. globiceps, N. platyfrons, Cryptoprocta antamba.*)

LANGE-SEEDECK, WERNER. Erfahrungen mit verschiedenen Zuchtverfahren beim Sumpfbiber. Deutsche Pelztierzüchter, München, vol. 14, no. 4, pp. 73–76. February 15, 1939.

LAURENT, P. Semi-albinisme chez le rat noir. Bull. sanitaire Algérie, Alger, no. 482, pp. 1494–1496. 1938.

——— Confirmation de la présence du rat alexandrin (*Rattus r. alexandrinus* Geoff.) a Beni ounif (Sud-oranais). Bull. sanitaire Algérie, Alger, no. 491, p. 1706. 1938.

LEONARDI, PIERO. Di una interessante monografia sugli Asinidi fossili europei e del rinvenimento di un dente di *Equus* (*Asinus*) *hydruntinus* Regalia nella Grotta Caprara presso Palermo. Archiv. Antrop e Etnol., Firenze, vol. 67, nos. 1–4, pp. 190–195, illus. 1937.

LERAAS, HAROLD J. Ecological distribution of the mammals of the Cranbrook area. Cranbrook Inst. Sci., Bull. no. 13, 20 pp., 2 pls. August, 1938. (Bloomfield Township, Oakland County, Michigan.)

LIEBUS, ADALBERT. Über neue Anthracotheriiden- und Suidenreste aus dem böhmischen Tertiär. Lotos, Prag, vol. 86, pp. 63–69, pl. 1. 1938.

LÖNNBERG, EINAR. Remarks on some members of the genus Cebus. Arkiv. f. Zool., Stockholm, vol. 31A, no. 23, pp. 1–24, tables. August 1, 1939. (New: *Cebus fatuellus tocantinus, C. libidinosus juruanus.*)

LOONEY, R. N. How Arizona was restocked with elk. Arizona Wildlife and Sportsman, Phoenix, vol. 1, no. 3, pp. 2, 7. March, 1939.

LYON, ROBERT A. Survival of deciduomata during lactation in the rat. Proc. Soc. Exper. Biol. and Med., New York, vol. 40, no. 2, pp. 151–152, table 1. February, 1939.

MACBRIDE, E. W. Further evidence for the Lamarckian Theory of the cause of evolution. Nature, London, vol. 143, no. 3614, pp. 205–206. February 4, 1939. (Accepts McDougall's results; see Drew.)

MACHÁČEK, K. Die Ergebnisse meiner Versuche in der Silberfuchszucht im Jahre 1937. Deutsche Pelztierzüchter, München, 13 Jahrg., no. 1, pp. 5–7. January 1, 1938.

MANWEILER, J. Woodland caribou in the "Big Bog." Minnesota Conservationist, St. Paul, no. 65, pp. 16–17, 23, 30, illus. February, 1939.

MATSUMOTO, H. Four notes on fossil mammalia. Jour. Geol. Soc. Japan, Tokyo, vol. 40, no. 479, p. 550. July 20, 1933. (In Japanese.)

MCATEE, W. L. The electric fence in wildlife management. Jour. Wildlife Manag., Menasha, Wisc., vol. 3, no. 1, pp. 1–13. January, 1939.

MCDERMOTT, WILLIAM COFFMAN. The ape in antiquity. Baltimore, Johns Hopkins Press, pp. xi + 338, pls. 10. 1938.

MCEUEN, C. S., H. SELYE, AND J. B. COLLIP. A pigmented adenoma of the intermediate lobe in a rat chronically treated with oestrin. Proc. Soc. Exper. Biol. and Med., New York, vol. 40, no. 2, pp. 241–244, figs. 2. February, 1939.

MEYER, K. F., B. EDDIE, AND B. ANDERSON-STEWART. Canine, murine, and human Leptospirosis in California. Proc. Soc. Exper. Biol. and Med., New York, vol. 38, no. 1, pp. 17–19. February, 1938.

MILLER, RUTH A. Observations upon the arrangement of the axillary artery and brachial plexus. Amer. Jour. Anat., Philadelphia, vol. 64, no. 1, pp. 143–163. January 15, 1939.

MOHR, ERNA. Kleine Beobachtungen am lebenden Riesengürteltier. Zool. Garten, Leipzig, n. F., vol. 10, nos. 5–6, pp. 198–202, figs. 6. January, 1939.

——— (Review of) Pratt, Ambrose, The call of the koala. Robertson and Mullens, Melbourne, pp. 120, figs. 24, 1937. Zool. Garten, Leipzig, n. F., vol. 10, nos. 5–6, pp. 242–245, illus., 1 table. January, 1939.

MORRISON-SCOTT, T. C. S. On the occurrence of a presumed first milk-molar (m.m.1) in African elephants. Proc. Zool. Soc. London for 1938, vol. 108, ser. B, Syst. and Morphol., pt. 4, pp. 711–713, pls. 1–2. January, 1939.

——— A key to the British bats. The Naturalist, London, no. 985, pp. 33–36, figs. 4. February, 1939.

——— Description of *Capromys nana* Allen, a supposedly extinct Cuban Hutia. Ann. Mag. Nat. Hist., London, ser. 11, vol. 3, no. 14, pp. 214–216, pls. 5–7. February, 1939.

——— Measuring mammals' tails. Ann. Mag. Nat. Hist., London, ser. 11, vol. 3, no. 14, pp. 216–219, figs. 3. February, 1939.

——— The identity of *Acomys megalotis* (Lichtenstein), described from Arabia. Ann. Mag. Nat. Hist., London, ser. 11, vol. 3, no. 14, pp. 238–240. February, 1939. (A synonym of *Acomys dimidiatus* (Cretz.))

——— The giant panda. Field, London, vol. 173, no. 4494, p. 283, illus. February 11, 1939.

MORSE, ARTHUR H., AND G. VAN WAGENEN. Observations upon ovulation in primates. Amer. Jour. Obstetrics and Gynecology, vol. 32, no. 5, pp. 823–832. 1936.

MOSSMAN, H. W., AND L. A. WEISFELDT. The fetal membranes of a primitive rodent, the thirteen-striped ground squirrel. Amer. Jour. Anat., Philadelphia, vol. 64, no. 1, pp. 59–110, pls. 10, table 1. January 15, 1939.

NAGAO, TAKUMI, AND SABURÔ ÔISHI. Geographical distribution of *Desmostylus*. Jour. Geol. Soc. Japan, Tokyo, vol. 42, no. 497, pp. 74–81. February 20, 1935. (In Japanese.)

NAGAO, TAKUMI. On the teeth of *Desmostylus*. Jour. Geol. Soc. Japan, Tokyo, vol. 42, no. 505, pp. 605–614, pls. 17–18. October 20, 1935. (In Japanese.)

NEWMAN, BARCLAY MOON. Dated chimpanzees. Yale's ape colony, in Florida, is a laboratory in which discoveries directly applicable to man are being made on man's closest relative, the ape. Scientific American, Lancaster, Pa., vol. 160, no. 2, pp. 71–73, illus. February, 1939.

NICHOLLS, LUCIUS. Period of gestation of Loris. Nature, London, vol. 143, no. 3615, p. 246. February 11, 1939.

NIEZABITOWSKI, EDWARD LUBICZ. Ueber die fossilen Ueberreste eines aus Grosspolen stammenden Wiesents. Kosmos, Lwow, vol. 63, no. 4, pp. 439–444, figs. 1. 1938. (In Polish, with German summary.)

——— Über einige bemerkenswerte fossile Reste augestorbener Säugetiere Polens. Kosmos, Lwow, vol. 63, no. 4, pp. 431–438, figs. 5. 1938. (*Elephas primigenius, Canis lupus, Felis leo spelaea.* In Polish, with German summary.)

NOBRE, AUGUSTO. Fauna marinha de Portugal. 2° Aditamento. Mamiferos. Cetaceos. Mem. e Estudos Mus. Zool. Univ. Coimbra, ser. 1, no. 108, p. 1. 1938. (*Balaenoptera musculus.*)

OKADA, YAICHIRO. A catalogue of vertebrates of Japan. Maruzen Co., Ltd., Tokyo pp. iv + 412. October, 1938. (Mammalia, pp. 1–25.)

OSGOOD, WILFRED H. An outworn nomenclatural practice. Science, n. s., vol. 89, no. 2297, pp. 9–11. January 6, 1939.

PARKER, HARRY C. A preliminary list of the mammals of Worcester County, Massachusetts. Proc. Boston Soc. Nat. Hist., vol. 41, no. 7, pp. 403–416. January, 1939.

PARKHAM, H. J. A nature lover in British Columbia. H. F. and G. Witherby, London, 292 pp., 21 pls. 1937.

PATA, ORESTE. Un nuova giacimento di ossa di mammiferi quaternari in contrada "Lapo" presso Villafranca Tirrena (Messina). Boll. Soc. Geol. Italiana, Roma, vol. 57, no. 3, pp. 331–334, fig. 1. March 20, 1939.

PEI, W. C. On the Upper Cave industry. Peking Nat. Hist. Bull., vol. 13, pt. 3, pp. 175–179, 3 pls. March, 1939.

PENCK, ALBRECHT. Säugetierfauna und Paläolithikum des jüngeren Pleistozäns in Mitteleuropa. Abhandl. Preuss. Akad. Wiss., Berlin, Jahrg. 1938, Physik.-math. Kl., no. 5, pp. 1–72. 1938.

——— Die Säugetierfauna des jüngeren Pleistozäns. Forschungen u. Fortschritte, Berlin, Jahrg. 15, no. 2, pp. 24–25. January 10, 1939.

PERRUCHE, LUCIEN. Le Musée de la mer de Biarritz. La Nature, Paris, no. 3045, pp. 167–171, figs. 10. March 15, 1939.

PERRY, CLAY. Ten thousand bats. Nature Magazine, Washington, D. C., vol. 31, no. 3, pp. 149–151. March, 1938. (Banded since 1932.)

PETZSCH, HANS. Neue Fundnachweise von Farbspielen des Hamsters (*Cricetus cricetus* L.). Zool. Anz., Leipzig, vol. 125, nos. 9–10, pp. 269–270. March 15, 1939.

PEYER, B. Über einen Schädelrest eines Carnivoren aus der Meeresmolasse von Wildensbuch, Kt. Zürich. Eclogae geol. Helvetiae, Basel, vol. 31, no. 2, pp. 311–316, figs. 4. December, 1938.

PFIZENMAYER, F. W. Mammut-Funde in Sibirien. Natur. u. Volk, Frankfurt a. M., vol. 67, no. 6, pp. 279–288, figs. 6–14. June, 1937.

PHILIP, CORNELIUS B. Ticks as vectors of animal diseases. Canadian Entomologist, London, Ont., vol. 71, no. 3, pp. 55–65. March, 1939.

PINCKNEY, PHILIP. Shooting in Sikkim. Jour. Darjeeling Nat. Hist. Soc., vol. 13, no. 3, pp. 105–114, illus. January, 1939. (The burrhel.)

PLISKE, EDWARD C. The follicular cycle in the sexually mature thirteen-lined ground squirrel (*Citellus tridecemlineatus* Mitch.). Jour. Morph., Philadelphia, vol. 63, no. 2, pp. 263–288. September, 1938.

POCHE, FRANZ. Supplement zu C. D. Sherborn's Index Animalium. Festschrift zum 60 Geburtstage von Prof. Dr. Embrik Strand, vol. 5, pp. 477–615. February 28, 1939.

POCOCK, R. I. The prehensile paw of the giant panda. Nature, London, vol. 143, no. 3614, p. 206. February 4, 1939.

——— The Fauna of Brit. India, including Ceylon and Burma, Mammalia, vol. 1, Primates and Carnivora (in part), Families Felidae and Viverridae, London, pp. xxxiii + 463, figs. 106, pl. 31, map. March 31, 1939.

POTOCKI, GEORGE. Two fine Polish trophies. The Field, London, vol. 164, no. 4275, p. 1304, illus. December 1, 1934. (Carpathian stag and elk.)

PRATT, AMBROSE. The call of the Koala. Robertson and Mullens, Melbourne, Australia, 120 pp., illus. 1937.

PREBLE, EDWARD A. The Arctic Caribou. National Nature News, Washington, D. C., vol. 3, no. 2, p. 11, illus. January 9, 1939.

PROX, A. Über die Untersuchung der Eckzähne und einiger krankhaft veränderter Unterkiefer des Höhlenbären aus der Steinmilchhöhle. Verhandl. u. Mitteil. des Siebenbürg. Ver. f. naturwiss. zu Hermannstadt, vols. 87–88, Jahrg. 1937–1938, 1 Wissenschaftlicher Teil, pp. 35–48, figs. 2, pl. 1, 4 tables. 1938.

PYCRAFT, W. P. Shrews, ancient and modern. Illus. London News, vol. 194, no. 5204, p. 63, figs. 4. January 14, 1939.

——— High-jumpers and great walkers. Illus. London News, vol. 194, no. 5206, p. 129, figs. 3. January 28, 1939. (Photos of living chimpanzee and jumping-hare.)

RAKOVEC, IVAN. Ein Moschusochs aus der Höhle Potočka Zijalka (Ostkarawanken). Prirodoslovne Razprave, Ljubljana, vol. 3, no. 10, pp. 253–262, pls. 1–2. 1938.

RATNOFF, OSCAR D. Anaphylaxis in the pregnant rat. Proc. Soc. Exper. Biol. and Med., New York, vol. 40, no. 2, pp. 248–251, table 1. February, 1939.

REED, SHELDON C. Determination of hair structure. I. The production of waved hair from genetically non-waved cells. Jour. Exper. Zool., Philadelphia, vol. 79, no. 3, pp. 347–354. 1938.

——— Determination of hair pigments. II. Transplantation of hair pigments. Jour. Exper. Zool., Philadelphia, vol. 79, no. 3, pp. 331–336. 1938.

——— Determination of hair pigments. III. Proof that expression of the black-and-tan gene is dependent upon tissue organization. Jour. Exper. Zool., Philadelphia, vol. 79, no. 3, pp. 337–346. 1938.

REES, J. W. The lion. Indian Wild Life, Agra, vol. 3, no. 4, pp. 208–212. October–December, 1938.

——— The bear. Indian Wild Life, Agra, vol. 4, no. 1, pp. [illegible]ry–March, 1939.

REIMANN, STANLEY P., AND NEVART CHATALBASH. The [illegible] of mouse skins treated with sulfhydryl, disulfoxide and [illegible]. Growth, Menasha, Wisc., vol. 1, no. 4, pp. 247–249. 19[illegible].

RODE, P. Catalogue des types de mammifères du Muséum [illegible] Histoire Naturelle. Ordre des Primates, sous-ordre des Simiens. Bull. Nat. Hist. Mus. Paris, vol. 10, pp. 201–251. 1938.

ROSEVEAR, D. R. The antelopes of Nigeria. The Nigerian Field, London, vol. 8, no. 1, pp. 9–10. January, 1939. (*Hippotragus* and *Oryx*.)

RUSCONI, CARLOS. Caries dentales en indigenas prehispanicos de Mendoza. Revista Odontologica, Buenos Aires, vol. 26, no. 9, pp. 388–392. September, 1938.

RZĄŚNICKI, A. Ein Maulesel im Warschauer Zoo. Zool. Garten, Leipzig, n. F., vol. 10, nos. 5–6, pp. 202–207, figs. 12. January, 1939.

SAKAI, E. On the locality of *Desmostylus*, south of Lake Sindi. Jour. Geol. Soc. Japan, Tokyo, vol. 42, no. 498, pp. 161–162, 1 fig. March 20, 1935. (In Japanese.)

SANBORN, COLIN CAMPBELL. Eight new bats of the genus Rhinolophus. Zool. Ser. Field Mus. Nat. Hist., Chicago, vol. 24, no. 5 (447), pp. 37–43. September 19, 1939. (New: *Rhinolophus keyensis annectens*, *R. chaseni*, *R. thomasi latifolius*, *R. t. septentrionalis*, *R. osgoodi*, *R. formosae*, *R. aethiops diversus*, *R. arcuatus angustifolius*.)

SCHÄFER, E. Der wilde Yak (*Bos* (*Poephagus*) *grunniens mutus* Prez.). Zool. Garten, Leipzig, n. F., vol. 9, nos. 1–2, pp. 26–34, figs. 6. 1937.

SCHAIK, IR. D. v. Over het voorkomen van de Groote Hoefijzerneus (*Rhinolophus ferrum equinum*) in Nederland. Natuurhist. Maandblad, Maastricht, 27e Jaargang, no. 3, pp. 22–24, illus. March 31, 1938. (In Dutch.)

SCHEFFER, VICTOR B. The os clitoridis of the Pacific otter. Murrelet, Seattle, vol. 20, no. 1, pp. 20–21, figs. 6. January–April, 1939. (*Lutra canadensis pacifica* Rhoads.)

SCHEIDEGGER, S., AND W. WENDNAGEL. Untersuchungen über die Pseudorachitis (Sternguckerkrankheit) der jungen Raubtiere. Zool. Garten, Leipzig, n. F.,

vol. 10, nos. 3–4, pp. 122–131, figs. 2. September, 1938. (Rickets-like softening of the bones in young carnivores is caused by a diet of meat from which the blood has been drained off without the addition of bone meal, p. 130.)

SCHMIDT, FRITZ. Polygame Rüden und polygame Zuchtmethoden in der Silberfuchszucht. Deutsche Pelztierzüchter, München, vol. 14, no. 2, pp. 25–30. January 15, 1939.

SCHREIBER, H. Vergleichende biologische Morphologie und Tiergärtnerei. Zool. Garten, Leipzig, n. F., vol. 10, nos. 3–4, pp. 131–139, figs. 4. September, 1938. (Wrist bones of orang and gibbon; foot bones of orang, chimpanzee, and man; liver of *Macacus rhesus*.)

SCHULZE, GG. Fleischaufbewahrung. Deutsche Pelztierzüchter, München, vol. 14, no. 4, pp. 80–83. February 15, 1939.

SCHULTZ, LEONARD P., AND EARL D. REID. Oak barrels for the storage of large alcoholic specimens. Turtox News, Chicago, vol. 17, no. 2, 2 pp., figs. 2. February, 1939.

SCHWARZ, ERNST. Menelik's bushbuck. Nature Magazine, Washington, D. C., vol. 31, no. 5, p. 308. May, 1938.

——— The reindeer. Nature Magazine, Washington, D. C., vol. 31, no. 10, p. 580. December, 1938.

——— Primitive cattle of Corsica. Nature Magazine, Washington, D. C., vol. 32, no. 1, p. 14, illus. January, 1939.

SCOTT, CLELAND. Protective coloration. Indian Wild Life, Agra, vol. 3, no. 4, pp. 201–207. October–December, 1938.

SCOTT, GORDON H., AND BRUCE L. CANAGA, JR. Cesium in the mammalian retina. Proc. Soc. Exper. Biol. and Med., New York, vol. 40, no. 2, pp. 275–276. February, 1939.

SCOTT, THOMAS G. Wildlife mortality on Iowa highways. Amer. Midland Nat., Notre Dame, vol. 20, no. 3, pp. 527–539. November, 1938.

SCOTT, W. M. A remarkable sabretooth-like creodont from the Eocene of Utah. Science, n. s., vol. 85, no. 2210, pp 454–455. May 7, 1937. (New: *Apatælurus kayi*.)

SCOTT, WILLIAM BERRYMAN, AND GLENN LOWELL JEPSEN. The mammalian fauna of the White River Oligocene. Pt. 2. Rodentia. Trans. Amer. Philos. Soc., Philadelphia, n. s., vol. 28, pt. 2, pp. 157–269, figs. 8–70, pls. 23–33. September, 1937. (New: *Ischyromys troxelli, Titanotheriomys wyomingensis, Proheteromys nebraskensis, Eutypomys magnus, Eumys parvidens, E. brachyodus, E. obliquidens, E. exiguus, Scottimus, S. lophatus, Cricetodon nebraskensis, Leidymys vetus*.)

SETH-SMITH, D. An upside-down life. The sloth and its very queer relations. The Field, London, vol. 164, no. 4275, p. 1297, illus. December 1, 1934.

SHANTZ, H. L. The bighorn and national forests. Conservation, Washington, D. C., vol. 5, no. 1, pp. 34–36. January–February, 1939.

SHAW, J. C. MIDDLETON. Further remains of a Sterkfontein ape. Nature, London, vol. 143, no. 3612, p. 117. January 21, 1939.

SHUTE, E. V. Cycle of responsivity of castrated albino mice and of human beings to oestrone injection. Nature, London, no. 3613, p. 161. January 28, 1939.

SMITH, RONALD W. A new geographic race of *Peromyscus leucopus* from Nova Scotia. Proc. Biol. Soc. Washington, vol. 52, pp. 157–158. October 11, 1939. (New: *Peromyscus leucopus caudatus*.)

STEHLIN, H. G. Zur Charakeristik einiger Palaeotherium-arten des oberen Ludien. Eclogae geol. Helvetiae, Basel, vol. 31, no. 2, pp. 263–292, figs. 17. December, 1938.

STEINBACHER, GEORG. Nüsse öffnender Sumpfichneumon. Zool. Garten, Leipzig, n. F., vol. 10, nos. 5–6, pp. 228–229. January, 1939. (*Mungos paludinosus.*)

STEKOL, JACOB A., AND HARRIMAN H. DASH. p-Bromophenol as the intermediate in synthesis of p-Bromophenylmercapturic acid from Bromobenzene in the rat. Proc. Soc. Exper. Biol. and Med., New York, vol. 40, no. 2, pp. 261–263, table 1. February, 1939.

STINEMETZ, MORGAN. One hundred aristocrats of the dog world. Natural History, New York, vol. 43, no. 2, pp. 96–101, figs. 100. February, 1939.

STIRTON, R. A. Significance of tertiary mammalian faunas in holarctic correlation with especial reference to the Pliocene in California. Jour. Paleont., Menasha, Wisc., vol. 13, no. 1, pp. 130–137, figs. 2. January, 1939.

——— Cenozoic mammal remains from the San Francisco Bay region. Bull. Dept. Geol., Sci., Univ. California Publ., Berkeley, vol. 24, no. 13, pp. 339–410, figs. 95, table 1. July 26, 1939. (New: *?Trilophodon simpsoni, ?Pediomeryx ruminalis, Tetrameryx irvingtonensis.*)

STOTT, KEN, JR. The spider monkey. Nature Magazine, Washington, D. C., vol. 31, no. 4, p. 205. April, 1938.

SUEIRO, M. B. BARBOSA. Contribution à l'étude de la morphologie du coude chez les mammifères. Arquivos Mus. Bocage, Lisboa, vol. 5, pp. 111–120, tables. 1934.

SYVERTON, JEROME T., WILLIAM W. STILES, AND GEORGE PACKER BERRY. Susceptibility of the "gopher" *Citellus richardsonii* (Sabine), to *Leptospira icterohemorrhagiae*. Proc. Soc. Exper. Biol. and Med., New York, vol. 39, no. 1, pp. 113–115. October, 1938.

TATE, G. H. H., AND RICHARD ARCHBOLD. Results of the Archbold Expeditions, no. 24. Oriental *Rhinolophus*, with special reference to material from the Archbold collections. Amer. Mus. Novitates, New York, no. 1036, pp. 12, tables. August 11, 1939. (New: *Rhinolophus pagi, R. maros.*)

TEILHARD DE CHARDIN, P. The Post-villafranchian interval in North China. Bull. Geol. Soc. China, Peking, vol. 17, no. 1, pp. 169–176. 1937.

TETLEY, H. On the British polecats. Proc. Zool. Soc. London, vol. 109, ser. B, pt. 1, pp. 37–39, pl. 1. May 5, 1939. (New: *Putorius putorius caledoniae.*)

TOKUNAGA, SHIGEYASU. On the geological age of Hôzan Coal Field, Chôsen. Jour. Geol. Soc. Japan, Tokyo, vol. 40, no. 475, pp. 179–182, 1 fig., pl. 8. April 20, 1933. (List of fossil mammals. In Japanese.)

TOURNEUR, N. The gerenuk. Nature Magazine, Washington, D. C., vol. 31, no. 2, p. 79. February, 1938. (*Litocranius.*)

TOKUNAGA, SHIGEYASU, AND FUYUJI TAKAI. Fossil elephants from Totigi Prefecture, Japan. Japanese Jour. Geol. and Geogr., Trans. and Abstracts, Tokyo, vol. 15, nos. 1–2, pp. 69–82, figs. 10, pls. 5–8. March, 1938.

TROUGHTON, ELLIS LEG. The platypus group. Life history exhibit in the Australian Museum. Australian Mus. Mag., Sydney, vol. 6, no. 11, pp. 363–367. July–September, 1938.

——— New marsupial groups in the Australian Museum. Australian Mus. Mag., Sydney, vol. 6, no. 8, pp. 255–259. October–December, 1937.

ULLRICH, HERBERT. Die Entstehung der Lungenwurmseuche unserer Cerviden und ihre Bekämpfung. Zool. Garten, Leipzig, n. F., vol. 10, nos. 3–4, pp. 147–152, figs. 4. September, 1938.

VAN DEINSE, A. B. Regeneration von einer bulla ossea einer *Balaenoptera musculus*. Archiv. Neerland. Zool., Leiden, vol. 3, sup., pp. 27–34. May, 1938.

VIRET, JEAN. Sur l'âge des argiles ligniteuses de Nassiet près Amou (Landes).

Comptes Rendus Acad. Sci. Paris, vol. 207, no. 12, pp. 500–501. September 19, 1938.

——— Sur l'origine des Mammifères. Bull. Soc. Linnéenne Lyon, 7e Année, no. 7, pp. 211–212. September, 1938.

——— Les Érinacéidés actuels et fossiles. Bull. Soc. Linnéenne Lyon, 7e Année, no. 5, pp. 142–144. May, 1938.

WEIDENREICH, FRANZ. Tatsachen und Probleme der Menschheitsentwicklung. Bio-Morphosis, Basel, vol. 1, fasc. 1, pp. 5–29. April, 1938.

WEINBERG, ARTHUR. Der Werdegang des deutschen Pferdes. Natur u. Volk, Frankfurt a. M., vol. 65, no. 9, pp. 412–448, figs. 46. September, 1935.

WEN-CHUNG, PEI. Le rôle des animaux et des causes naturelles dans la cassure des os. Palaeontologia Sinica, Peiping, n. s. D, no. 7, whole ser. no. 118, pp. 1–60, 21 pls., 4 figs. 1938.

WENDNAGEL, AD. Ein Schwärzling der Indischen Goldkatze (*Felis temminckii* Vig. Horsf.) Zool. Garten, Leipzig, n. F., vol. 10, nos. 3–4, pp. 114–115, figs. 3. September, 1938.

WIGHT, H. M. Food taken by the eastern skunk (*Mephitis m. nigra*), with particular reference to birds and bird eggs. Pennsylvania Game News, New Cumberland, vol. 9, no. 3, pp. 12, 13, 30, 4 figs. 1938.

WILHELM, J. H. Das Wild des Okawangogebiets und des Caprivizipfels. Jour. S. W. African Sci. Soc., Windhoek, vol. 6, pp. 51–74, illus. 1933.

WILSON, JOHN A. A new species of dog from the Miocene of Colorado. Contrib. Mus. Paleont., Univ. Michigan, Ann Arbor, vol. 5, no. 12, pp. 315–318, figs. 2. July 1, 1939. (New: *Cynodesmus casei*.)

WINDLE, W. F., M. MONNIER, AND A. G. STEELE. Fetal respiratory movements in the cat. Physiol. Zool., Chicago, vol. 11, no. 4, pp. 425–433. October, 1938.

YOUNG, C. C. The forerunner of *Sinanthropus pekinensis*. Bull. Geol. Soc. China, Peking, vol. 17, no. 2, pp. 137–144. 1937.

——— New vertebrate horizons in China. Bull. Geol. Soc. China, Peking, vol. 17, nos. 3–4, pp. 269–287. 1937.

OBITUARY NOTICE

ROBERT MARSHALL

Robert Marshall, a life member of the American Society of Mammalogists, died suddenly of a heart attack while en route from Washington to New York on November 11, 1939, at the age of 38. Born January 2, 1901, he was graduated from the College of Forestry, of Syracuse University, in 1923 and did his graduate work at Harvard and Johns Hopkins universities.

Although his academic training centered in botany and forestry, he was also much interested in sociological problems. He spent 13 months in northern Alaska, and thereafter published "Arctic Village," a sociological study of life in an isolated community. To this region, which he loved so well, he afterward returned on two more trips, and published his experiences in privately printed leaflets for his friends. Another book, "The Peoples' Forests," presents his theories on the management of forests.

He was a member of the Explorers' Club, of various learned societies, a founder and moving spirit of the Wilderness Society, and for 4 years Chief Forester with the Office of Indian Affairs. Since 1937 he had been Chief of the Division of Recreation and Lands in the United States Forest Service.

The New York Times of December 1 tells us that Robert Marshall "left practically all of his estate for the preservation or maintenance of wilderness conditions in America, preservation of civil liberties, and for education in economic conditions," and that "his will directed that his residuary estate be divided into four parts, which are to be held in trust, one part for the creation of a charitable trust to 'preserve wilderness conditions in outdoor America and to increase the knowledge of the citizens of the United States of America as to the importance and necessity of maintaining wilderness conditions in outdoor America for future generations.' "

Secretary of the Interior Ickes, on hearing of Bob Marshall's passing, said: "The wild areas he worked so hard to perpetuate remain as his monuments," and it was announced by the Secretary of Agriculture that a wilderness area in some western forest will be named in his honor. Such indications of a continuance of his wilderness recreation policies are very gratifying to his fellow enthusiasts. Generous, friendly, sincere in all things, Bob, as the special friend of the under-privileged, dreamed of making outdoor recreation more available to them. Gifford Pinchot said: "He gave himself to the service of his country in the finest spirit, working tremendously when he had no need to work; and what he accomplished in forestry and the conservation of natural beauty out-of-doors and in many other ways was worthy of the man."—OLAUS J. MURIE, *U. S. Biological Survey, Jackson, Wyo.*

COMMENT AND NEWS

TWENTY-SECOND ANNUAL MEETING

For reasons connected with the war, it has been found necessary to change the place of meeting of the next annual meeting of the Society, which was announced to be held in Toronto.

The Directors have voted to hold the next meeting, June 25-29, 1940, at the Colorado Museum of Natural History, Denver, Colorado.

The President has appointed the following as the Committee on Arrangements:

Alfred M. Bailey, Chairman, The Colorado Museum of Natural History, Denver, Colorado.

E. R. Kalmbach, U. S. Biological Survey, 562 Custom House, Denver, Colorado.

Hugo Rodeck, University of Colorado Museum, Boulder, Colorado.

Julia Smead, The Colorado Museum of Natural History, Denver, Colorado.

C. C. Sperry, U. S. Biological Survey, 1455 South Franklin Street, Denver, Colorado.

Edward R. Warren, 1511 Wood Avenue, Colorado Springs, Colorado.

Further information will appear in the May number of the Journal.

SLAUGHTER OF BUFFALO AT WAINWRIGHT BUFFALO PARK

We have received from J. Dewey Soper, Chief Federal Migratory Bird Officer, Prairie Provinces, Winnipeg, Manitoba, the following statement in reference to the abandonment of Wainwright Buffalo Park:

Wainwright Buffalo Park was established to help save the North American bison from extinction. This venture was notably successful; now the danger of extermination no longer exists.

Aside from the Wainwright herd, Canada possesses, in total, many thousands of bison at Elk Island National Park, Wood Buffalo Park, and at numerous other places. The herds at Wood Buffalo Park comprise the largest bison aggregate in North America, and probably in the world. The primary purpose of saving the bison from extinction was well fulfilled at Wainwright and this can now be fully maintained in the large herds possessed elsewhere in the Dominion. This makes Wainwright Park unnecessary.

The range at Wainwright Buffalo Park was subject to progressive deterioration, which of late years became very pronounced. The soil is light and there was overgrazing; the several years of severe drought hastened deterioration. Supplementary farming operations became necessary to feed the herds and this changed the whole character of the enterprise from natural to artificial conditions.

Conditions were investigated last summer by Dr. Seymour Hadwen, Director of Pathology and Bacteriology, Ontario Research Foundation, who is the outstanding authority on buffalo and deer problems on this continent, and the action which the Department is taking is based on a careful study of conditions which have been verified by Dr. Hadwen's survey.

The slaughter at Buffalo Park, Wainwright, this year, will be carried on under the supervision of the Park Superintendent and of a Government meat inspector. The shooting will be done by expert marksmen who have had extended experience in this line of work and the buffalo meat will be cared for in accordance with modern methods in the abattoir by the packing company which has secured the meat and hides by competitive tender.

BIOLOGICAL ABSTRACTS

We are advised by the secretary of the Union of Biological Societies that the price for Abstracts of Experimental Animal Biology (see Jour. Mamm., vol. 20, p. 137) has been reduced to $8.00, and for Abstracts of Animal Sciences to $5.00.

Seton's LIVES OF GAME ANIMALS

The publishers of the four volume edition of Seton's "Lives of Game Animals" announce that they are closing out this edition at $10 per set, plus carrying charges. The retail price has been $20. The text is the same as the eight volume set of the previous edition.

Address all orders to Doubleday, Doran & Co., Garden City, New York.